

MERCURY POLLUTION PREVENTION IN MICHIGAN

**Summary of Current Efforts and
Recommendations for Future Activities**

**A REPORT BY THE MICHIGAN MERCURY
POLLUTION PREVENTION TASK FORCE**

**April 1996
Final Report**

DEDICATION

This report is dedicated to Kim Paksi, Michigan Department of Environmental Quality, Environmental Assistance Division. Kim is a member of the Mercury Pollution Prevention Task Force who has dedicated several years of her life to improving Michigan's environment through pollution prevention endeavors. Kim has been on extended sick leave since November 1994 and has not been able to participate in the formal Task Force meetings. Kim introduced us to the definition of pollution prevention and the hierarchy of priorities when we began our deliberations. We have tried to develop a report keeping these concepts in mind, and we hope that she is proud of this compilation of 14 months of work from which we believe Michigan's citizens and environment will benefit.

We look forward to her imminent return to the Department,

The Michigan Mercury Pollution Prevention Task Force

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GLOSSARY OF ACRONYMS

| | |
|------------------------|--|
| AAMA | American Automobile Manufacturers Association |
| ABS | Antilock Braking Systems |
| AIAM | Association of International Automobile Manufacturers |
| AQD | Air Quality Division - MDEQ |
| ATSDR | Agency for Toxic Substances and Disease Registry |
| AWR | Annual Wastewater Report |
| BTU | British Thermal Unit |
| CAA | Clean Air Act |
| CMR | Critical Materials Report |
| CWA | Clean Water Act |
| DOD | Department of Defense |
| DOE | Department of Energy |
| dscm | Dry Standard Cubic Meter |
| DSM | Demand Side Management |
| DWSD | Detroit Water and Sewage Department |
| EAD | Environmental Assistance Division - MDEQ |
| EIS | Environmental Impact Statement |
| GLNPO | Great Lakes National Program Office - USEPA |
| Hg⁰ | Elemental Mercury |
| HID | High Intensity Discharge |
| km | Kilometers |
| M2P2 Task Force | Michigan Mercury Pollution Prevention Task Force |
| MACT | Maximum Achievable Control Technology |
| MCC | Michigan Chemical Council |
| MDA | Michigan Dental Association |
| MDEQ | Michigan Department of Environmental Quality |
| MDNR | Michigan Department of Natural Resources |
| MDPH | Michigan Department of Public Health |
| MEC | Michigan Environmental Council |
| MeHg | Methylmercury |
| MESB | Michigan Environmental Science Board |
| MHA | Michigan Health and Hospital Association |
| MIOSHA | Michigan Occupational Safety & Health Administration |
| MMP | Mercury Minimization Plan |
| MPCA | Minnesota Pollution Control Agency |
| MPSC | Michigan Public Service Commission - Department of Commerce |
| MRP | Mercury Reduction Plan |
| MUCC | Michigan United Conservation Clubs |
| MWC | Municipal Waste Combustor |
| MWI | Medical Waste Incinerator |
| NEMA | National Electrical Manufacturers Association |
| NPDES | National Pollutant Discharge Elimination System |
| NREPA | Natural Resource and Environmental Protection Act |
| NWF | National Wildlife Federation |

| | |
|---------------------|--|
| OAQPS | Office of Quality Planning and Standards - USEPA |
| P2 | Pollution Prevention |
| ppb | Parts Per Billion |
| PCBs | Polychlorinated Biphenyls |
| POTWs | Publicly Owned Treatment Works |
| ppm | Parts Per Million |
| RAPIDS | Regional Air Pollutant Inventory Development System |
| RCRA | Resource Conservation and Recovery Act |
| SAE | Society of Automotive Engineers |
| SWQD | Surface Water Quality Division - MDEQ |
| TCLP | Toxicity Characteristic Leaching Procedure |
| TRI | Toxic Chemical Release Inventory |
| µg | Micrograms |
| USCAR | United States Council for Automotive Research |
| USFDA | United States Food and Drug Administration |
| USEPA | United States Environmental Protection Agency |
| UWR | Universal Waste Rule |
| VE | Virtual Elimination |
| VRDC | Vehicle Recycling Development Center |
| VRP | Vehicle Recycling Partnership |
| WMD | Waste Management Division - MDEQ |
| WWTP | Wastewater Treatment Plant |

MIOSHA

BTu value is much lower for wood than coal, therefore more wood would need to be burned than coal to equate to the same BTu value.

NEMA -NREPA

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Summary of Current Efforts and Recommendations for Future Activities
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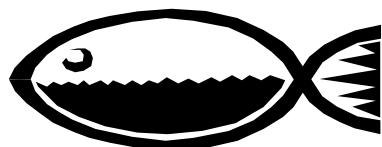
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EXECUTIVE SUMMARY

The toxicity and use of the naturally occurring element mercury has been recognized for thousands of years. The state of Michigan has identified mercury as one of the primary pollutants of concern for decades. Mercury contaminated fish have resulted in the Michigan Department of Public Health issuing a state-wide fish advisory in 1988, for all of Michigan's 11,000 inland lakes. Several accidental poisonings of mercury have also occurred in the state because of the various uses and lack of understanding of mercury hazards. Because mercury is toxic, the uses continue to decline. From 1983 to 1994, the United States use of mercury decreased by approximately 72%. However, the unique chemical and physical properties of mercury promote its continued use in certain applications.



...methylmercury can build up in fish tissue and cause a potential risk to humans and animals...

In Michigan it is estimated that between approximately 8,400 to 10,400 pounds of mercury are released to the atmosphere annually. Mercury emissions have decreased in recent years and are expected to continue to decline. This decrease is primarily a result of facilities adding mercury controls or closing down their operations known to emit mercury. Between 200 to 1,800 pounds of mercury are discharged to Michigan waters, and approximately 3,800 pounds of mercury are discarded in the municipal and commercial waste stream. Mercury can enter water bodies through direct discharge, nonpoint runoff or from atmospheric deposition which is the most significant source. Mercury in aquatic systems can be converted by microorganisms into methylmercury, a bioaccumulative form that can build up in fish tissue causing a potential risk to humans and animal species that consume the fish. Methylmercury is a neurotoxin, and the developing fetus is most at risk from methylmercury poisoning. At this time the direct contribution from various mercury sources to mercury levels in fish are not known. The mercury that is deposited into lakes can originate from local sources or other states or other countries because mercury is volatile and can be transported by winds thousands of miles before being deposited. The issue is, therefore, a regional concern and even a national and international one.

In 1991 Michigan Governor John Engler announced that a Michigan mercury reduction strategy would be developed. The state responded by developing and releasing two mercury reports. A background document on the mercury state-of-knowledge was assembled in 1992 by a state

department workgroup and was utilized by Governor John Engler's Michigan Environmental Science Board (MESB) as a background document for their report, titled, "Mercury in Michigan's Environment: Environment and Human Health Concerns" completed in April 1993. A Mercury Action Plan was developed to address the recommendations identified in the MESB report and resulted in the formation of the Michigan Mercury Pollution Prevention Task Force hereinafter **M2P2 Task Force**, which was convened August of 1994. Among its conclusions the MESB stated that "...there is not a demonstrable public health threat from methylmercury contamination in Michigan fish at this time." The MESB went on to say, "There is a potentially small margin of safety between background (i.e., natural) levels of mercury exposure and concentrations that can cause harm in humans. These factors add uncertainty to conclusions about the current health risk and preclude predictions regarding future health risks. Mercury must be taken seriously as a potential threat to public health and the environment." The report also stated, "Michigan has the ability to reduce its contribution to atmospheric mercury within the Great Lakes region. Given this, and in light of the potential human health threat which can result from local as well as regionally derived mercury in the environment, Michigan should take necessary steps to reduce controllable mercury emissions within its borders"

In response the M2P2 Task Force has initiated a variety of mercury reduction efforts and outlined specific recommendations to users of mercury-containing products or devices, including business, industry, state government and the general public to further reduce mercury in the environment. These efforts should be guided by the pollution prevention policy articulated by the federal Pollution Prevention Act of 1990, which endorses source reduction as the preferred approach. The pollution prevention hierarchy, as set out in the 1990 Act, Section 6602(b) is as follows:

- "1) Pollution should be prevented or reduced at the source whenever feasible;
- 2) Pollution that cannot be prevented should be recycled in an environmentally safe manner whenever feasible;
- 3) Pollution that cannot be prevented or recycled should be treated in an environmentally safe manner whenever feasible; and
- 4) Disposal or other release into the environment should be employed only as a last resort and should be conducted in an environmentally safe manner."

(This hierarchy may need to be reevaluated concerning the recycling of mercury. For example, in 1991 Sweden's parliament decided that all uses of mercury should be phased out by the year 2000. The Swedish EPA has also recommended that mercury not be reclaimed for recycling or reuse. They believe that the only feasible long-term solution is that mercury be stored permanently in a geological repository. The Swedish EPA believes that exporting the waste for recycling or final disposal in another country is not an acceptable option.)

The M2P2 Task Force identified the known Michigan anthropogenic sources of mercury and followed the pollution prevention hierarchy in their deliberations, activities and in compiling their recommendations. The M2P2 Task Force approach was to work cooperatively with the stakeholders to identify opportunities for mercury pollution prevention activities. Education and outreach was a key priority in working with the stakeholders. In order to facilitate communication efforts the M2P2 Task Force focused on six sector subgroups including the

general public, health care, dental, electrical manufacturers/users, chemical manufacturers/users and the automobile sector. The M2P2 Task Force recognized that the mercury issue extends beyond Michigan's borders and have promoted their objectives and goals beyond state boundaries. The M2P2 Task Force was able to achieve numerous accomplishments concurrent with its deliberations.

MICHIGAN MERCURY POLLUTION PREVENTION TASK FORCE ACCOMPLISHMENTS

(The following activities were either accomplished by a M2P2 Task Force member, or the M2P2 Task Force efforts were an impetus in completing or initiating the effort/project.)

- 1) Produced and distributed the MERC CONCERN Brochure to media, private organizations, local government and health departments.***
- 2) Obtained a grant from the Saginaw Bay National Watershed Initiative, Michigan Office of the Great Lakes, for the Genesee County Health Department, Environmental Health Services Division, to conduct a mercury education/outreach and mercury-containing waste collection pilot project.***
- 3) Participated in mercury education/outreach efforts utilizing the Mercury Display assembled by the Minnesota Pollution Control Agency under a grant from the United States Environmental Protection Agency (USEPA).***
- 4) Reviewed and assisted in the development of the health care brochure titled, "The Case Against Mercury: Rx for Pollution Prevention" funded by USEPA.***
- 5) Obtained a grant from the USEPA for a health care industry seminar on mercury pollution prevention.***
- 6) Obtained a grant from the USEPA for education/outreach to medical waste incinerators in Michigan.***
- 7) Identified mercury sources and alternatives in the health care industry.***
- 8) Compiled a list of mercury pollution prevention hospital case studies.***
- 9) Initiated a collection and disposal of "bulk" mercury from dental offices in Michigan.***
- 10) Encouraged the Environmental Assistance Division - Michigan Department***

of Environmental Quality (MDEQ), to develop a flyer on low mercury caustics for use at technical assistance training for Michigan industries.

- 11) Initiated contacts with General Motors, Ford and Chrysler resulting in their commitment to phase out mercury in switches and other applications, where feasible and to develop removal guidelines for dismantlers for current vehicles to foster safe handling and disposal.*
- 12) Initiated contacts with the Society of Automotive Engineers resulting in the development of a mercury “white paper” focusing on pollution prevention opportunities at the design end of the automotive business.*
- 13) Promoted P2 efforts with U.S. and Canadian auto suppliers at the North American Auto Supplier Environmental workshop; October 20, 1995, Toronto, Canada.*
- 14) Promoted mercury P2 efforts at the Waste Reduction Energy Efficiency Workshop, Livonia, Michigan on December 14, 1995, cofunded by AAMA and MDEQ.*
- 15) Provided recommendations to the Chairpersons of the National Mercury Task Force on a variety of mercury reduction initiatives.*



“Implementing prudent P2 measures will help protect the health of Michigan’s citizens and wildlife”



MICHIGAN MERCURY POLLUTION PREVENTION TASK FORCE CONCLUSIONS AND RECOMMENDATIONS

Numerous opportunities exist in Michigan for mercury pollution prevention efforts. The M2P2 Task Force identified several of these opportunities and, where possible, initiated mercury pollution prevention activities. Implementing prudent pollution prevention measures will help protect the health of Michigan's citizens and wildlife and will reduce unnecessary risk to humans and the environment while avoiding the need for spending significant amounts of money to clean-up mercury in the environment. The M2P2 Task Force has also made recommendations to the National Mercury Task Force for actions at the national level since mercury is deposited in Michigan from non-Michigan sources. The M2P2 Task Force recommends that current efforts underway should continue and the state of Michigan, specific state departments and other identified agencies and associations should provide the necessary resources for these mercury pollution prevention activities. While lead agencies or associations have been identified, these groups should not work alone. They should provide leadership for all stakeholders involved. The M2P2 Task Force offers the following additional recommendations be implemented:

Recommendations

General Public Subgroup Recommendations:

1) The State of Michigan should undertake an aggressive, comprehensive state-wide education/awareness campaign with strong support from the Governor to the lead agency to alert people on ways they can reduce mercury pollution.

The following tools should be developed as part of the state-wide education/awareness campaign:

- **MDEQ should develop a mercury manual, involving all stakeholders.** Information, including an overview of mercury toxicity, known sources and alternatives, spill clean-up precautions and procedures, household hazardous waste and recycling centers that accept mercury-containing products and pollution prevention alternatives are examples of information that should be included in the manual.



- **MDEQ, involving all stakeholders, should develop energy conservation and energy efficiency material for distribution.**

The material should emphasize the link between reduced mercury emissions from reduced burning of fossil fuels from energy conservation and efficiency efforts.

- **MDEQ should develop a mercury concern video.**
- **The Governor of Michigan, the Director of the Office of the Great Lakes and the Director of MDEQ and the Director of MDPH should call upon retailers to voluntarily cease distribution of toys, games and clothing containing mercury.**
- **Michigan Department of Education should develop a mercury fact sheet and/or video for science teachers.**
- **Michigan Department of Education should develop a mercury education/awareness component for school curriculum.**
- **MDPH should continue distribution of educational materials for women of childbearing age with regard to eating Michigan fish.**

2) Decentralize the education/outreach process by working with local counties and cities encouraging mercury P2 education/outreach at a local level (The City of Detroit's Water and Sewerage Department and the Genesee County education/outreach efforts could be models.)

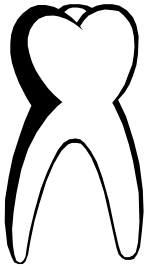
Health Care Subgroup Recommendations:

3) MDEQ working in cooperation with the Michigan Health and Hospital Association should send letters to all Michigan health care facilities encouraging the phase out of mercury-containing products/devices by continuing mercury P2 efforts while allowing for the exercise of judgment by health care professionals.

4) MDEQ and the Michigan Health and Hospital Association should continue the education outreach process with the health care industry. Hospitals, nursing homes and medical office buildings should be included in this target group.

5) Hospitals should discontinue the practice of sending mercury thermometers home with newborns.

6) MDEQ should evaluate veterinary clinic uses of mercury and encourage similar mercury P2 activities as in the human health care industry.



The healthcare subgroup, not necessarily the entire M2P2 Task Force, also recognizes that if voluntary P2 efforts are not successful in reducing mercury in health care institutions, then legislation should be considered, including legislation that sunsets the sale of mercury products and devices in the health care industry and legislation that requires health care facilities to demonstrate that they have instituted a process to reduce uses and separate wastes known to contain mercury from their waste stream before wastes are shipped for incineration or incinerated on site.

Dental Subgroup Recommendations:

7) Encourage the National Institute of Dental Research and the American Association of Dental Schools to emphasize the use of dental amalgam alternatives, which could eventually replace the use of mercury in dental restorations and obviate the need for sophisticated and expensive filtration systems and proper handling procedures.

8) The M2P2 Task Force calls upon all Michigan dental offices to eliminate the use of bulk mercury.

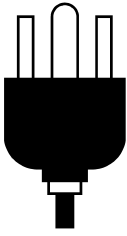
9) The American Dental Association, the Michigan Dental Association and Michigan Schools of Dentistry should increase education among dental personnel about proper dental amalgam waste collection and disposition.

10) MDEQ and the Michigan Dental Association should use the city of Detroit's effort to reduce discharge of mercury waste from dental facilities as a pilot for the rest of the state to follow.

11) MDEQ and the Michigan Dental Association should encourage insurance companies to develop payment plans which include competitive coverage for alternatives to dental amalgams.

12) MDEQ and the Michigan Dental Association should develop and implement an amalgam waste tracking system.

13) MDA should encourage the American Dental Association or the International Standards Organization and the National Sanitation Foundation to conduct efficiency testing on the systems marketed for the capture of waste amalgam.



14) The National Institute of Dental Research, the American Dental Association and dental manufacturers should conduct additional research on restorative material alternatives and also capture technology for dental amalgam waste.

Electrical Manufacturers/Users Subgroup Recommendations:

15) MDEQ should continue mercury P2 education and outreach efforts by informing users of the various types of batteries that contain mercury and provide information on alternatives and available recycling centers.

16) MDEQ should ensure that mercury battery manufacturers comply with Michigan's new battery law.

17) MDEQ should work with lamp manufacturers and encourage their continued effort to reduce the quantity of mercury required for operation and encourage development of economically feasible alternatives with comparable energy efficiency ratings.

18) MDEQ should continue to work with USEPA to encourage facilities to participate in USEPA's Green Lights program.

19) MDEQ should continue its effort on incorporating the universal waste rule (UWR) into Michigan regulations to include such mercury-containing wastes as thermostats, batteries, banned pesticides and mercury-containing lamps as universal wastes. (The final UWR was published FR vol. 60, No. 91, May 11, 1995. This final UWR rule streamlines the hazardous waste management regulations governing the collection and management of batteries, pesticides and thermostats.) **Further, MDEQ should seek expansion of the rule to include mercury-containing switches, thermometers and mercury-containing medical devices to simplify the collection and recycling of these wastes.** [In October 1995 MDEQ-WMD proposed revisions to update its hazardous waste rules and adopt the UWR (Administrative rules to Part 111 of NREPA, 1994 PA 451, as amended. MDEQ-WMD has proposed the inclusion of thermostats, batteries, banned pesticides and mercury-containing lamps as universal wastes.)]



20) MDEQ should determine if fluorescent light barrel crushers are a significant source of fugitive mercury emissions to the atmosphere and develop a policy/recommendation on this process.

21) MDEQ should encourage Michigan facilities to participate in the Honeywell Corporation's reverse distribution recycling program for mercury-containing thermostats.

22) MDEQ should extend the educational/outreach campaign and collection program for products containing mercury in the Lake Superior Basin to Michigan's lower peninsula.

Chemical Manufactures/Users Subgroup Recommendations:

23) The M2P2 Task Force recommends the Michigan Chemical Council undertake an assessment of the quantities and types of mercury used by the Michigan chemical industry and the voluntary pollution prevention methods being used to prevent releases to the environment and share with MDEQ for public dissemination.

24) All stakeholders should be involved in the development of a national labeling requirement for products or components which contain a significant percentage of mercury for its function or as an added ingredient. This would allow consumers and businesses to make informed choices in efforts to support pollution prevention progress.

25) Michigan should provide incentives to promote voluntary pollution prevention efforts. Many of these efforts have already been extremely successful. Incentives could include tax credits or grants that could be given to companies for pollution prevention training and education.

26) Increase the dialogue with industry toward further voluntary pollution prevention initiatives. At the national level the Chemical Manufacturer's Association Responsible Care® program may be the appropriate avenue to bring more focus on mercury pollution prevention opportunities in the chemical industry. Ongoing involvement of the Michigan Chemical Council is encouraged at the state level.



27) The M2P2 Task Force urges the continued effort by the MDEQ industrial pretreatment program staff to disseminate information to local pretreatment authorities and others on mercury-containing products and processes and opportunities for P2.

28) The thresholds for mercury emissions under the Toxic Chemical Release Inventory (TRI) may need to be evaluated. This reporting threshold may be of questionable utility given that the present reporting threshold for mercury is 10,000 pounds/year and the Michigan anthropogenic atmospheric emissions are estimated to be between 8,000-10,000 pounds/year.

TRI reporting is required by Section 313 of Title III of the 1986 Superfund Amendments and Reauthorization Act (SARA 313).

29) The Michigan Chemical Council and MDEQ should work cooperatively at improving the inventory of mercury released into Michigan's environment from the Michigan chemical industry to improve the scientific base of knowledge in Michigan.

30) With the assistance of the manufacturing and chemical sectors the MDEQ should undertake more educational efforts on P2 efforts regarding mercury. The informational flyer on aqueous cleaners is a good example of what might be done (Appendix I).

Automobile Subgroup Recommendations

31) The American Automobile Manufacturers Association should develop a mercury-containing switch removal procedure for current vehicles by dismantlers to foster safe handling and disposal.

32) MDEQ should follow up on the letter from the Association of International Automobile Manufacturers (AIAM) requesting assistance in addressing disposal/recycling needs regarding mercury switches in the current fleet of their member company vehicles.

33) The American Automobile Manufacturers Association or MDEQ should provide the switch removal procedure to AIAM for a determination of applicability to the vehicles noted in recommendation 32 above.



34) MDEQ should provide adequate resources for quality assurance checks on the Michigan Critical Materials Report and computer processing if the report is to provide a reliable basis for monitoring use and potential releases of mercury in the future.

Utility Sector Recommendations:

35) The M2P2 Task Force, MDEQ and the Michigan Public Service Commission should encourage USEPA to finalize the mercury and utility studies and ensure that significant resources are allocated to determine the scientific basis to promulgate national standards for mercury emissions from electric utility boilers.

36) The Michigan Public Service Commission and the MDEQ, working in cooperation with Michigan utilities, should support additional research efforts to evaluate the full environmental costs and impacts of mercury emissions and subsequent deposition from electric power generation.

37) Michigan utilities should continue to support projects on evaluating renewable energy sources, including wind and solar energy. The results of all applicable studies should be shared with the PSC and MDEQ and if determined to be economically and technically feasible additional reliance on renewables should be implemented.

38) The M2P2 Task Force calls upon electric utilities to factor in the costs and benefits of mercury emissions control into all Environmental Impact Statements (EIS) required under federal and state law.

39) The M2P2 Task Force calls upon Michigan utilities to develop a plan with timetables and goals that are measurable, in quantitative or other terms, as well as means to achieve the goals, to further reduce mercury usage or emissions from the

generation of electricity and/or other sources. This plan should be submitted to MDEQ and MPSC and progress in achieving mercury reductions should be reported on an annual basis. (See Section 4.4 for the list of various types of activities that could be implemented to reduce mercury usage or emissions from Michigan utilities.)



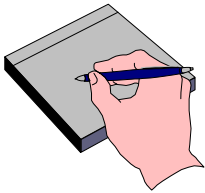
State Government Recommendations:

40) Michigan should allocate the necessary resources to implement the mercury P2 recommendations within this report.

41) MDEQ should take the lead in continuing to facilitate the implementation of the numerous recommendations in this report. These recommendations encompass communication, coordination, education, training and decentralization of mercury P2 efforts to the local level. The following are more specific recommendations to the MDEQ, but should involve all stakeholders:

- **Facilitate P2 by other state departments regarding mercury.**
- **Define success.** i.e. how do we measure success of mercury reduction efforts?
- **Continue communication with manufacturers and end users of mercury-containing products/devices and identify potential mercury pollution prevention possibilities and encourage implementation.**
- **Develop a “mercury manual” for the MDEQ-EAD** **Environmental**
Assistance Center, involving all stakeholders and share with MDEQ district offices.
- **Coordinate the development of additional education/outreach materials.**
- **Work with the various divisions in MDEQ (air, water and waste) to coordinate permitting and compliance issues related to mercury.**
- **Include mercury P2 information in MDEQ staff training.**
- **Develop a mechanism to recognize mercury-free**
companies/institutions or companies/institutions that have made a significant
mercury reduction effort.
- **MDEQ should consider a periodic mercury meeting with key stakeholders to maintain focus on voluntary mercury P2 efforts and accomplishments.**





The State of Michigan should first set a positive example by implementing mercury P2 activities:

42) Become a USEPA Green Lights Partner.

43) The State of Michigan Department of Management and Budget (DMB) should develop a state purchasing policy that identifies mercury-containing products and purchases mercury-free alternatives, when available.

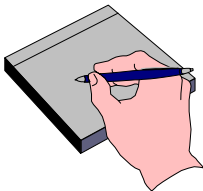
44) The State of Michigan should recycle mercury-containing products and wastes, where feasible.

45) MDEQ and the Michigan Department of Public Health (MDPH) should provide the necessary resources to improve Michigan's mercury inventory data within the state and establish databases of information on mercury. Necessary resources should be provided to MDPH and the line divisions of MDEQ including Surface Water Quality Division (SWQD), Air Quality Division (AQD), Waste Management Division (WMD) and the Environmental Assistance Division (EAD) to better quantify mercury sources and evaluate trends within the state. Examples of data needed would include sediment, fish and human tissue monitoring data.

Suggested Mercury Legislation

The following Mercury legislation should be considered to facilitate mercury P2 efforts.

- **The State of Michigan should create, by statute, a Michigan Energy Bank with the authority to finance energy audits and energy-related capital improvements for public buildings, including those occupied by state agencies and local school districts.** Energy efficiency projects can reduce the demand for electricity supplied by coal-fired power plants, which may reduce the consumption of coal by these power plants. Reducing the consumption of coal, reduces the release of mercury to the atmosphere by coal-fired power plants.

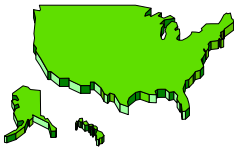


- **The State of Michigan should enact legislation or revise rules that brings the state's hazardous waste regulations into conformance with the universal waste rule as it pertains to mercury thermostats, batteries and banned pesticides. Further, Michigan should seek expansion of the rule to include mercury-containing lamps and switches, thermometers and mercury-containing medical devices to simplify the collection and recycling of these wastes.**
- **The State of Michigan should enact legislation that educates the public on the responsibility of individuals to divert mercury-bearing materials from the municipal waste stream. Similar to legislation enacted in Minnesota, the legislation should prohibit the knowing disposal by any person of mercury-bearing thermometers, toys, games, batteries, fluorescent lights and thermostats in a waste stream directed to an incinerator. Because the legislation is designed to educate**

individuals and businesses, it should specifically exempt incinerator operators from enforcement for violations committed in the normal course of incinerator operation. (This recommendation should be evaluated following implementation of the CAA, Section 129 standards that requires mercury controls for all municipal waste combustors.)

The Healthcare Subgroup, not necessarily the entire M2P2 Task Force, also recognizes that if voluntary P2 efforts are not successful in reducing mercury in health care institutions, then legislation should be considered, including:

- **The State of Michigan should support legislation that requires health care facilities to demonstrate that they have instituted a process to reduce uses and separate wastes known to contain mercury from their waste stream before wastes are shipped for incineration or incinerated on site.**

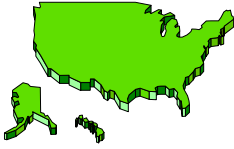


Recommendations for a National Effort

The following recommendations were made to the National Mercury Task Force

- 1) Establish a national public education/awareness and outreach program to educate consumers and end-users of mercury-containing products on pollution prevention opportunities and available alternatives to these products as well as energy conservation opportunities. The educational information should explain the link to fish consumption advisories with focus on subsistence fish eating populations. The information should raise the awareness of the public about mercury cycling in the environment, and its toxicity potential and persistence.**
- 2) Emphasize mercury P2 efforts through existing EPA initiatives such as Project XL, 33/50, the Common Sense Initiative or model an effort that follows the national lead education and abatement program.**
- 3) Increase dialogue with industry and manufacturers on ways to decrease and/or eliminate mercury from products and processes. These discussions should also include consideration of the effects of imported mercury-containing products and mercury stock availability (domestic and imported) on emissions and P2 efforts. Organizations approached should include trade associations, broad based organizations and voluntary standards organizations such as the American National Standards Institute (ANSI) and the American Society of Testing and Materials (ASTM). For example, discussions should consider the use of environmental management systems and life cycle analysis in the development of product related standards to help raise the awareness of design engineers about toxic substances, including mercury, at the front end of product development.**

4) Encourage voluntary phase out of nonessential uses of mercury and replacement with environmentally safe alternatives. Many states are reluctant to act in the absence of a consistent, national policy which levels the playing field. EPA could show leadership by creating a national forum with the states and other key stakeholders in regards to mercury emissions and reduction guidelines.

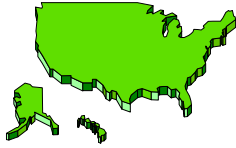


- 5) Expand the Universal Waste Rule for mercury-containing products, such as fluorescent lamps, switches, high-intensity discharge lamps, thermometers and mercury-containing medical equipment.
- 6) Foster voluntary national recycling and/or buy back programs for mercury-containing wastes including fluorescent lights. The recycling effort for fluorescent lights could possibly be in conjunction with the EPA Green Lights Program.
- 7) Continue EPA's effort to encourage national energy conservation, including communications on the benefits of reduced emissions of pollutants from fossil fuel burning. EPA should broaden its effort by working in cooperation with the Department of Energy.
- 8) Develop a national labeling requirement for products or components which contain a significant percentage of mercury for its function or as an added ingredient. This would allow consumers and businesses to make informed choices in efforts to support pollution prevention progress.
- 9) Continue EPA's effort to find an alternative to the incineration of organo-mercuric wastes. Pursuant to RCRA, an allowed treatment of organic wastes containing mercury is incineration. This practice has contributed to the anthropogenic mercury loadings into the environment in Michigan and may undermine many of the current P2 efforts underway.

Additionally, the following research and data needs were recommended to the National Mercury Task Force:

(Recommendations number 1-6 were adopted from the Michigan Environmental Science Board's report, "Mercury in Michigan's Environment: Environmental and Human Health Concerns (A Science Report to Governor John Engler)" April 1993.

- 1) Pregnant women in the nation should be periodically monitored to determine the current level of exposure to mercury and whether the exposure is changing. Hair and/or blood should be sampled at intervals not exceeding 5 years.



2) Ambient air monitoring should be conducted in and around urban areas to determine the sources and the geographic extent of high mercury concentrations. Elevated levels of ambient mercury have been found in Detroit and Chicago.

3) Undertake a national-scale investigation to obtain speciated mercury measurements in the plumes of all major mercury emission source types. This information is needed to determine which sources should be controlled and the impact any control measure will have on observed mercury concentrations. Plume measurements are much more useful than stack measurements because some gaseous mercury-two in the stack is likely to condense out to particulate mercury-two after exiting the stack. Concurrent stack and plume measurements will help determine the rate of this transformation.

4) Conduct a national study on mercury mass balance in clouds to provide insight on the importance of nucleation scavenging versus in-cloud oxidation. Cloud chambers could be utilized to test the importance of in-cloud elemental mercury oxidation, gaseous mercury-two washout and particulate mercury-two nucleation scavenging. This needs to be done in order to determine which form of mercury should be controlled.

5) Make a determination as to whether or not soils are a net source or sink for mercury by applying state-of-the-art dry deposition measurement techniques. Vertical profiling as a function of time of day and season are needed to characterize this source/sink. This information is needed in order to quantify the impact of reducing anthropogenic mercury emission sources.

6) EPA should establish a central repository to collect and maintain information resulting from various states, federal, regional and international research investigations and information on various state, federal and international legislative initiatives. The collected information should be developed into a comprehensive and up-to-date database on mercury. Currently, there is no single agency that tracks all the various mercury research issues.

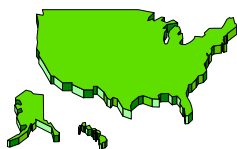


7). EPA should use multi-route exposure assessment modeling before establishing national emission limits for sources known to emit mercury. (Municipal waste incinerator standards and other incinerator standards must consider the bioaccumulative impacts of mercury in establishing adequate control levels. These standards should also include requirements for source reduction and pollution prevention of mercury-containing materials.)

8) Provide additional resources for the development of continuous emission monitoring (CEM) of mercury from such sources as incinerators and utilities.

9) In efforts to improve the scientific base of knowledge, the reporting thresholds for mercury emissions under the Toxic Chemical Release Inventory (TRI) may need to be evaluated. TRI reporting is required by Section 313 of Title III of the 1986 Superfund Amendments and Reauthorization Act (SARA 313).

10) EPA's Science Advisory Board, perhaps through the Clean Air Science Advisory Committee (CASAC), should review and scientifically evaluate the accumulated mercury information and provide recommendations to the Administrator based on new data and/or advancements in the understanding of mercury in the environment. As new research information becomes available, there will be a need for EPA to scientifically evaluate the material in terms of its impact on ongoing and/or proposed programs.



The M2P2 Task Force Also Recommends the Following Efforts be Implemented on a National Scale:

- **Michigan should challenge analytical standards setting agencies including EPA and the Standard Methods Joint Editorial Board to address mercury pollution prevention opportunities through revisions to approved analytical methods and directions for laboratory use, handling and recycling or proper disposal of mercury.**
- **Michigan should pursue other sector standard setting organizations associated with the design phase of products which may have a significant impact on eliminating/ lowering mercury use in future products. (Efforts similar to the SAE P2 white paper should be pursued by the State and other key stakeholders - see Section 3.6.3.)**

- USEPA should pursue a voluntary P2 initiative for mercury with the chlor-alkali industry. Emphasis should be placed on conversion from the mercury cell process to either the membrane cell or diaphragm cell process. Although no facilities are located in Michigan, our state can be impacted by atmospheric transport and deposition from out-of-state facilities.

1.0 INTRODUCTION

Mercury (quicksilver):



a naturally occurring ubiquitous element that is found in air, water and soil. One form of naturally occurring mercury is cinnabar ore, primarily composed of mercuric sulfide. Because it is the only heavy metal that exists as a liquid at room temperature, has high electrical conductivity, alloys with other metals and is toxic to living organisms, it has been used in thousands of industrial, agricultural, medical and household applications. Elemental mercury (Hg^0) itself can be toxic especially if inhaled, but this element can also be methylated by microorganisms in aquatic systems into an even more toxic organic form, methylmercury (MeHg). MeHg is highly bioaccumulative and persistent in fish tissue. There are no known physiological requirements for mercury in the human body.

cause damaging health effects.”



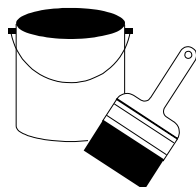
“Prolonged or acute exposure to mercury may

1.1 Historic Global Perspective of Mercury

The toxicity and use of mercury has been known for centuries. The Romans sentenced their prisoners to work in cinnabar ore mines during the early Roman empire. The prisoners consequently died by the thousands from exposure to mercury vapors.¹ Precolonial native Americans ground cinnabar into a powder that was used as a red war paint for their tribal ceremonies.² In the 1800s, mercury was also used in the manufacturing of felt hats, in which the colloquial term “mad as a hatter” was coined to describe the physical symptoms of inorganic mercury poisoning in workers from this mercury use.³

Prolonged or acute exposure to mercury may cause damaging health effects. The adverse health effects are dependent on the form of mercury the individual is exposed to, the dose and the exposure route. For example, the primary route of exposure to methylmercury (MeHg) in humans is from fish consumption. In extreme incidents the nervous system and the brain can be adversely effected. The developing fetus is most sensitive to MeHg poisoning. Widespread poisonings in Minamata, Japan through fish consumption in the 1950s and Iraq in the 1970s,

through consumption of mercury-treated grain, unfortunately provided unequivocal evidence of the toxicity of MeHg leaving thousands of people dead from methylmercury poisoning.^{4&5} Exposure to elemental mercury (Hg^0) can occur in occupational settings including hospitals and dental offices. Inhalation of gaseous Hg^0 may cause



“...today no mercury is used in paints...”

shakiness (tremors), memory loss and kidney disease. However, Hg^0 is less toxic when ingested because this form is minimally absorbed by the body.

Because of the recognized toxicity of mercury, uses continue to decline. From 1983 to 1994, the United States consumption of mercury decreased by approximately 72%.⁶ The most notable decline in mercury use was in batteries and in paints. From 1983 to 1994, mercury use in battery manufacturing fell 99%. Today no mercury is used in paints. The unique chemical and physical properties of mercury still promote its continued use in thermometers, switches and as a preservative. In 1994, the United States Bureau of Mines recorded that significant mercury uses still continue for the manufacturing of chlorine and caustic soda, laboratory uses, other chemical products, electrical and electronic uses, measuring and control instruments and dental equipment and supplies. Historical and current uses of mercury are outlined in **Appendix A**.

Mercury poisoning incidents led to numerous environmental policies and reports on recommended mercury use phase outs and reduction efforts. In 1973, the Organization for Economic Co-Operation and Development (OECD) member countries that included 16 countries such as Sweden, Japan, Canada and the United States convened a “Council on Measures to Reduce All Man-Made Emissions of Mercury to the Environment.” This Council made several recommendations that were adopted on September 18, 1973 including a recommendation to reduce all man-made emissions of mercury to the environment to the lowest possible levels, with particular attention to alkylmercury compounds and mercury in discharges from all industrial plants using or manufacturing products containing mercury.⁷ The Council also requested member countries to submit reports annually on quantities of mercury used and discharged to air, water and land for agricultural uses and in the pulp and paper and chlor-alkali industries.⁸

The OECD member countries chose mercury as one of the five groups of chemicals to be included in a pilot project on co-operative risk reduction efforts in 1992. The OECD released a summary of the risk reduction activities for the member countries in 1994.⁹ This report provided a “snapshot” of the environmental regulations governing mercury for member countries.

Today, environmental management of this bioaccumulative substance in the world ranges from countries that are working towards the goal of complete mercury elimination to developing countries that continue to use mercury for gold recovery. The Swedish Parliament decided that the use of mercury must cease by the year 2000.¹⁰ Most mercury-containing measuring instruments and electrical components have already been successfully phased out in Sweden. The Swedish Environmental Protection Agency proposed that mercury-containing waste should not be reclaimed, reused or exported, and other solutions must be investigated.¹¹ Sweden is currently conducting research on developing a permanent underground repository for mercury, similar to their disposal for radioactive waste.¹²

The use of mercury, however, continues in the Amazon region of Brazil where severe environmental mercury contamination has occurred as a result of the continued use of mercury for gold recovery. Approximately 500,000 gold prospectors visit the Amazon region annually,¹³ and it is estimated that between 70 - 100 tons of mercury is emitted annually from the gold mining process.¹⁴ Some miners who heat the gold/mercury amalgam show signs of mercurialism.¹⁵ Abnormally high levels of mercury were observed in fish collected near the gold mining area, as well as in the hair and blood from the inhabitants of nearby fishing villages.¹⁶

1.2 Background on Mercury in Michigan, 1970s - Present

1970s

“...fish mercury levels in Lake St. Clair and the St. Clair River decreased to low levels in most species by the late 1980s...”



Mercury has been recognized as an environmental pollutant of concern for decades in Michigan. In 1970, mercury contamination was found in Lake St. Clair and the St. Clair River fish as a result of six tons of mercury being discharged into the waters annually from the Dow Chemical chlor-alkali complex in Sarnia, Canada.¹⁷ For a short period of time, a Governor's Executive Order made it illegal to fish in Michigan waters of Lake St. Clair due to the mercury levels. The Michigan Water Resources Commission soon thereafter established a policy which stated that there would be no direct discharges of mercury to the waters of the state. Consequently, the most significant direct water discharges of mercury were eliminated in Michigan by 1972; and the severely contaminated fish mercury levels in Lake St. Clair and the St. Clair River decreased to low levels in most species by the late 1980s. However, fish advisories for 12 fish species in Lake St. Clair still exist as a result of elevated mercury levels.¹⁸

This calamitous release of mercury into Michigan's environment resulted in a state report on recommendations to reduce mercury contamination. In 1970, The Michigan House of Representatives enlisted the assistance of the Director of Michigan Department of Natural Resources (MDNR). The Director of MDNR requested the assistance of Dr. Frank D'Itri, Assistant Professor at Michigan State University to find solutions to the mercury contamination problem. The recommendations of Dr. D'Itri included changes in Michigan regulations including:

- Ban the use and sale of all alkylmercury-containing compounds in Michigan.. They are simply too toxic to be used safely;
- Establish a complete inventory of mercury uses and amounts discharged. The use of mercury-containing pesticides should also be severely restricted and they should be used only when there is a demonstrated and urgent need for the compound;
- Require that all manufacturers, especially in the chlor-alkali industry, reduce their discharges of mercury into the total environment - air, water, and land - at least to the background levels of that area. The background levels may be difficult to assess, but they could be determined approximately through the average mercury content of unpolluted parts of the state.
- Register all users of more than one pound of any form of mercury within the State of Michigan and require them to provide a yearly accounting of their mercury inventory wherein all losses should be identified.
- Require all large users of fossil fuels, except individual home owners in Michigan, to determine the amounts of mercury present in the coal or crude oil before it is burned or converted into another product. The mercury content of ash should also be required to be determined.
- Require that all compounds or products which contain mercury state this information on the product or package; and the citizenry should be requested not to incinerate these products. Furthermore, the state could set up collection depots where people could dispose of mercury-containing products. And all manufacturers and farmers should be encouraged to use nonmercurial fungicides and pesticides.

- Reinstate the catch and release rule for all fish caught in the St. Clair River and Lake St. Clair until the mercury levels decrease significantly in fish taken from the area. The authority for this action is vested in the MDPH.¹⁹

At that time efforts to implement the above recommendations were viewed as too resource intensive, lacked political support and were never implemented.²⁰

1980s-1990s

The Michigan Department of Environmental Quality (MDEQ)⁽¹⁾ and the Michigan Department of Public Health (MDPH) continued to collect and analyze fish tissue throughout the 1980s and 1990s. Many fish tissue samples collected in remote inland lakes were found to exceed the recommended MDPH fish consumption advisory limit (0.5 mg/kg). Between the years of 1985 and 1994, MDEQ and MDPH have collected and analyzed fish from 202 inland lakes. The data show that 133 lakes out of the 202 tested (66%) had and least one fish in the sample exceeding 0.5 mg/kg. Approximately 33% of the lakes had at least one fish species with an average concentration over 0.5 mg/kg. Seventeen of the lakes had at least one fish exceeding MDPH's "do not eat" trigger limit of 1.5 mg/kg. In 1988, MDPH issued a state-wide fish consumption advisory for all of Michigan's 11,000 inland lakes.²¹ The advisory includes walleye, pike and bass species as well as some of the larger sizes of perch and crappie (over 9 inches). MDPH advises that the general public only eat one meal per week and that nursing mothers, pregnant women, women who intend to have children, and children under the age of 15 should not eat more than one meal per month of these species. Michigan is only one of at least 37 states that currently has some form of a mercury fish advisory in place.

It is important to note that MDPH does not recommend that people stop eating fish. Fish is a very good source of protein and low in saturated fats. Michigan's citizens can still get the benefits of eating fish by wisely selecting the types of fish consumed. Most fish species' mercury levels clearly increase with the size of the fish. Small pan fish, such as perch, rock bass and crappie (less than 9 inches) and bluegill and sunfish of all sizes are very low in MeHg. Whereas, larger, older predatory fish such as walleye, bass and pike often contain higher levels of MeHg. Unlike PCBs, dioxin or other fish contaminants, mercury concentrates in the muscle not the fat, therefore trimming the fat or grilling will not significantly reduce MeHg levels. Exposure to MeHg can also occur from eating certain ocean fish. Swordfish and shark are two popular species that have average concentrations exceeding the higher US Food and Drug Administration (USFDA) trigger limit of 1.0 mg/kg. In 1979, USFDA was ordered by a court ruling to raise their trigger limit from 0.5 mg/kg to 1.0 mg/kg due to the economic impact of the lower limit on several large marine species of importance in the commercial market. MDPH advises that nursing mothers, pregnant women, women who intend to have children, and children under the age of 15 should not eat any swordfish or shark. There are no known MeHg poisonings to Michigan citizens from the consumption of fish.

¹ On October 1, 1995, by Executive Order 1995-18, the Michigan Department of Natural Resources (MDNR) was divided into the MDNR and the new Michigan Department of Environmental Quality (MDEQ).

Environmental Mercury Cycle

The source of mercury to these remote inland lakes has now been widely recognized as atmospheric deposition.^{22&23} Anthropogenic atmospheric sources encompass such combustion sources as electric utilities that burn coal and oil, municipal and medical waste incinerators and ore smelting.²⁴ Other atmospheric sources include natural sources (forest fires or volcanoes) and re-emissions of previous deposited mercury. Mercury released from past sources can still continue to cycle through the environment. The release of mercury into the atmosphere means it can be deposited locally, regionally or even globally. All forms of mercury deposited in water are available for methylation by microorganisms; MeHg can bioaccumulate from 100,000 to 1,000,000 times in fish tissue posing a threat to humans and wildlife that consume the contaminated fish.²⁵ In Canada, the Cree Indians have been reported to suffer from what they call "fish disease".²⁶

In 1989, the MDEQ-Air Quality Division (AQD) received a permit application to construct a municipal waste incinerator in Oakland County, Michigan. MDEQ-AQD requested that a multi-route exposure assessment be conducted to determine local health impacts. This evaluation includes estimating human exposure to toxic air pollutant emissions from the proposed source via inhalation and ingestion (fish consumption). The modeled concentration of mercury estimated to be deposited into a nearby lake exceeded the MDEQ-Surface Water Quality Division (SWQD) Rule 57 water quality standard. The controversy over this proposed source led to the announcement by Governor John Engler in 1991 at the International Joint Commission meeting that a Michigan mercury strategy would be developed. In 1994, the applicant formally withdrew the pending application for this proposed municipal waste incinerator.

Recent Michigan Mercury Reports

The mercury strategy announcement by Governor John Engler was the impetus behind the formation of a state mercury workgroup. Participants in this workgroup included staff of the MDEQ, MDPH and Michigan Department of Agriculture (MDA). This state mercury workgroup drafted and released a report on the state-of-knowledge on mercury in 1992, titled, "Mercury in Michigan's Environment: Causes and Extent of the Problem."²⁷ In 1992, Governor Engler convened the Michigan Environmental Science Board (MESB) with their first directive to investigate the problem of mercury contamination. Governor John Engler directed the Board to investigate the risk posed to Michigan citizens by excessive levels of mercury; to determine the sources of mercury and the pathways by which mercury enters the environment; and propose and evaluate options for controlling or eliminating harmful emissions of mercury to the environment. The MESB utilized the state report as background information; collected additional data; and released their report in April 1993, titled, "Mercury in Michigan's Environment: Environmental and Human Health Concerns" (A Science Report to Governor John Engler).²⁸ Key points included in the Executive Summary of the MESB report were that, "...there is not a demonstrable public health threat from methylmercury contamination in Michigan fish at this time." The MESB went on to say, "There is a potentially small margin of safety between background (i.e., natural) levels of mercury exposure and concentrations that can cause harm in humans. These factors add uncertainty to conclusions about the current health risk and preclude predictions regarding future health risks. Mercury must be taken seriously as a potential threat to public health and the environment." The report also stated, "Michigan has the ability to reduce its contribution to atmospheric mercury within the Great Lakes region. Given this, and in light of the potential human health threat which can result from local as well as regionally derived mercury in the environment, Michigan should take necessary steps to reduce controllable mercury emissions within its borders."

The MESB recommendations, on pages 56-58 of their report, that address mercury reductions and improved mercury data collection in Michigan, included:

mercury emissions from incinerators.."

*"...Michigan
should follow
the lead of
others in
making
reduction of
mercury at the
source and
collection/
recycling
programs an
immediate and
integral part of
reducing*

- "...serious voluntary and mandatory source reduction, separation and collection programs with appropriate incentives and penalties may be the most satisfactory responses to the problems associated with mercury and other components of the solid waste stream. Even highly effective air pollution control equipment only succeeds in moving mercury from one environmental medium to another. There

is little assurance that mercury and other hazardous components deposited in landfills will remain out of the general environment permanently.

Mercury and other problematic heavy metals last forever; constructs of human engineering do not.” ... “Michigan should follow the lead of others in making reduction of mercury at the source and collection/recycling programs an immediate and integral part of reducing mercury emissions from incinerators. For example, reduction of mercury use in packaging, electric cells, switches, lamps and other sources as well as mandatory collection strategies are already a part of Minnesota and New Jersey programs. Michigan should work with other states and the federal government to elicit their cooperation with strict emission limits and source reduction since mercury and other pollutants respect no boundaries. Efforts of public education and voluntary actions are necessary but, alone, are insufficient strategies to solve mercury and other problems associated with waste disposal.”

- “The state of Michigan should consider designing a self-financing collection and recycling program for mercuric oxide batteries which establishes effective and fair incentives to recycle.”
- “Michigan and the federal government need to be much more serious about waste reduction, detoxification and reuse. This is consistent with state and federal objectives but sufficient funding, incentives and laws and regulation have been lacking. Regulations and technology continue to change regularly as more is learned about the complexities of conversion and containment of problem substances from incineration.”
- “Any remaining uncontrolled sources of solid waste combustion (e.g., apartment, school and store incinerators) should continue to be phased out and hospital incinerators should be brought under stricter regulation for mercury and other emissions. Florida and Tennessee have enacted a moratorium on permits for new medical waste incinerators. If studies document that these sources, are, in fact, important contributors to mercury deposition in Michigan, the state may want to consider this option until such time as adequate control technologies become available.”
- “Facilities which incinerate hazardous waste should be required to include mercury in their incineration monitoring since there are significant amounts of mercury potentially available (either knowingly or unknowingly) for input into combustion devices. Particular attention should be paid to industrial boilers, furnaces and cement kilns which accept hazardous wastes. These facilities have little capability of capturing mercury in the off-gases because they are generally

not fitted with wet scrubbing devices. Mercury input and emissions limits should be set as a permit condition for all existing and proposed facilities which receive hazardous waste.”

- “...the Michigan Department of Commerce - Public Service Commission (PSC) [should] be directed to require utilities to perform testing on their facilities to determine the amounts and the forms of mercury in their emissions so that they are in a position to determine which emission control technologies are most appropriate for their specific facilities and in a position to accurately assess their contribution to the total mercury emission inventory. Because it is not possible to characterize the best available technologies for controlling mercury emissions from coal-fired power plants at this time, a prudent strategy for the state would be to require its utilities to develop the information needed to make future permitting decisions. In particular, source samples to measure the concentrations of the various mercury forms are needed to ensure development of truly effective control technologies.”... “These data requirements could be instituted as part of the PSC's regular process of reviewing long range generating capacity plans, and the costs of the research could be recovered through modest increases in utility rates.”
- “All facilities that are potential significant sources of airborne mercury should be required to perform speciated source testing so that a more realistic emissions inventory can be developed. Optimum and cost effective control strategies can only be developed based on reliable emissions information.”

The MESB report also contains recommendations on what further studies may be needed to implement the above charges including additional information on the abundance, transport and fate of mercury in the Michigan environment; current levels and trends of mercury exposure of Michigan citizens and mercury emission rates from Michigan facilities.

Following the release of the MESB report, a Michigan Mercury Action Plan was developed and signed by MDEQ, MDPH and the Department of Commerce - PSC in December 1993 to address the recommendations identified in the MESB mercury report and was submitted to Governor John Engler. The Mercury Action Plan embodied the commitment to convene a Mercury Pollution Prevention Task Force.

1.3 Examples of Human Mercury Exposure and Mercury Spills in Michigan, 1980s-1990s

In addition to the MeHg exposure concern via the consumption of fish, human exposure also occurs through inhalation of Hg⁰ and some forms of organic mercury. There have been numerous accidental spills and poisoning from mercury reported in Michigan since the 1980s because of the various uses and lack of understanding of mercury toxicity. Examples include:

- 1989 - Four people died in Lincoln Park, Michigan when one of the individuals attempted to recover silver from dental amalgams through a home smelting process. This released mercury throughout the home in lethal amounts. All four of the individuals died from mercury poisoning within 11-24 days after exposure.²⁹
- 1989 - A four year old boy was diagnosed with acrodynia, a rare manifestation of childhood mercury poisoning, from the inhalation of mercury vapors released from latex paint application. In October 1989, the Michigan Department of Agriculture prohibited further sales of the inappropriately formulated paint that contained phenylmercuric acetate beyond the allowed EPA limit.³⁰ In response to pressure of a USEPA mandatory cancellation of mercury in latex paints, the paint manufacturing companies responded in 1990 by a “voluntary” cancellation of all product registrations nationally for mercury in interior latex paints. In 1991, the cancellation was extended to mercury in exterior latex paints, following the failure of the two remaining companies that had registrations to provide USEPA with the data necessary to assess potential risks and benefits of using mercury in their product.³¹
- 1989 - Three children were hospitalized in Grand Rapids, Michigan as a result of mercury poisoning, one of the children was no longer able to walk. Investigation revealed that exposure occurred after a small vial of mercury was spilled in the children’s bedroom approximately two-three months prior to detection of the gross symptoms.³²
- 1991 - A child in Belleville, Michigan stole mercury from a dental office, distributed it into plastic bags and shared it with his friends. Some of the mercury was spilled at an elementary and nursery school resulting in closure of the schools for two weeks during clean-up and decontamination.³³
- 1992 - A Chippewa County museum closed temporarily for clean-up after a mercury spill that occurred from refilling the mercury from an antique lighthouse light.³⁴
- 1993 - A mercury spill at a Grand Rapids, Michigan middle school resulted in children being evacuated and required a hazardous waste clean-up company to decontaminate the building. (No adverse health effects were reported.)³⁵
- 1993 - 1995 Several mercury spills at a Grand Rapids hospital were reported that resulted in expensive clean-up and decontamination procedures (It cost approximately \$3,000 to clean-up each mercury spill.)³⁶
- 1993 - A popcorn machine exploded at a movie theater in Fenton, Michigan that resulted in a mercury switch breaking and mercury was spilled onto the machine and popcorn. The theater was evacuated and a hazardous waste clean-up company was contracted. It cost approximately \$6,000 to decontaminate the spill area. The switch was replaced by the theater owner with a dry contact relay alternative that cost \$12.50.³⁷

- 1995 - Children found mercury in their father's garage in mid-Michigan and took it to school. Four children were exposed, the affected area was decontaminated the same day, and no health effects were reported.³⁸

Several other mercury spills have been reported in 1995 including a spill in a home from a broken counter weight in an antique Grandfather clock, a woman spilled mercury in her vehicle from a broken thermometer and mercury was spilled in a mini-van from an individual transporting a sphygmomanometer (blood pressure device) that broke during transportation. These examples further highlight the importance and need for education and awareness for mercury and for a comprehensive mercury pollution prevention approach in the state of Michigan.

1.4 Sources of Mercury in Michigan

Identification of the specific sources of mercury is essential in order to implement appropriate pollution prevention measures. The 1992 "Mercury in Michigan's Environment" report contained a state estimate of mercury released from various sources. This information has been updated and is outlined in **Appendix B**. The MDEQ-AQD estimated that Michigan facilities emitted between approximately 8,400 to 10,400 pounds of mercury into the atmosphere in 1994. The most significant sources were combustion sources including electric utilities and incineration. Mercury emissions have decreased in recent years, and are expected to continue to decline. This decrease is primarily a result of facilities adding mercury controls or closing down their operations known to emit mercury. For example, the Greater Detroit Resource Recovery Authority municipal waste combustor in 1993 emitted approximately 600 pounds of mercury annually. Since June 1994, this facility has retrofitted their air pollution controls with a spray dryer and fabric filter which has significantly reduced their mercury emissions. The most recent stack test in July 1994, showed annual emissions of approximately ten pounds per year. Another significant reduction of mercury emissions occurred from the White Pines copper smelter, located in Michigan's upper peninsula, that ceased operating their smelter, indefinitely. This facility emitted approximately 1,400 pounds of mercury on an annual basis. Continued mercury emission reductions are expected from incinerators as a result of mercury emission standards promulgated under the 1990 Clean Air Act (CAA). Municipal waste combustor standards were promulgated December 19, 1995 that require 85% reduction of mercury emissions or the facility must meet the mercury emission limit of 80 µg/dscm. Medical waste incinerator standards are expected to be final spring of 1996.

MDEQ-AQD also estimated that approximately 3,800 pounds of mercury was discarded with municipal and commercial solid wastes for 1995. The MDEQ-SWQD estimated that Michigan facilities discharged between 200-1,800 pounds of mercury to municipal wastewater treatment plant or to surface water and groundwater of the state in 1991, the most recent data available. The MDEQ-WMD estimated that 251 Michigan facilities generated approximately 900,000 pounds of mercury-containing wastes in 1994. Additionally, MDEQ-WMD estimated that 10 Michigan facilities received approximately 7.5 million pounds of mercury-containing wastes for treatment, storage or disposal in Michigan.

These source estimates of mercury used and released in Michigan help focus the need and opportunities for additional reduction in mercury released to the environment. The Michigan Mercury Pollution Prevention Task Force has made significant progress to better identify specific mercury uses and known alternatives.

Atmospheric Deposition of Mercury

Overall, the contribution of mercury into the environment is most significant from air emissions. However, it is not known at this time what percentage of the emissions are currently deposited within Michigan's borders. The "relative contribution of local, regional, and global sources is location specific and cannot be extrapolated from one place to another."³⁹ The Expert Panel on Mercury Atmospheric Processes stated local scale is a relative term, used to describe the area within which emissions can travel in one diurnal cycle (generally within 100 km of a source).⁴⁰ This panel defined regional scale as a relative term used to define that area requiring more than one diurnal cycle emission transport time (about 100 to 2,000 km from a source). Global cycle models have indicated that about half of the anthropogenic mercury emissions are deposited within a local or regional-scale area, usually within 1,000 kilometers of the emission source.⁴¹ Studies have been conducted in Michigan that demonstrate a regional-scale deposition gradient within the Great Lakes region. The data suggest that the sources of mercury are of "regional origin (within and outside Michigan) and that proximity to known anthropogenic sources significantly influence the concentration and wet deposition of mercury in the Great Lakes basin."⁴² Recent data in Michigan have also demonstrated that mercury levels in urban areas are highly elevated.⁴³ For example, mercury sources in the Detroit Metropolitan area have been shown to contribute to elevated mercury concentrations and wet deposition in southeastern Michigan.⁴⁴

The State of Minnesota, based on published literature, estimated that 10 percent of all mercury emitted will be deposited within 10 kilometers of the source.⁴⁵ They acknowledge that it is not known how much their state will benefit from reducing emissions within their state. However, their state task force recommended that, "Minnesota should nevertheless reduce its emissions because there will be some direct benefit to the Minnesota environment, and because our reduction strategies have served and will continue to serve as models for other states and the federal government."⁴⁶ Minnesota's ultimate goal is to reduce mercury in the environment to, preindustrial background levels.

"...Because mercury is naturally occurring, disruptions of the earth from volcanoes or mining can also release additional mercury into the environment..."

Natural Sources of Mercury

Mercury is a naturally occurring element; numerous mercury-bearing minerals exist including cinnabar, magnolite and potarite.⁴⁷ Because mercury is naturally occurring, disruptions of the earth from volcanoes or mining can also release additional mercury into the environment. Earlier estimates documented anthropogenic and natural emissions contributing approximately 50% each of mercury to the global atmosphere.⁴⁸ However, new data suggest that anthropogenic

emissions represent "between 50 and 75 percent of the total yearly input to the atmosphere from all sources."⁴⁹

2.0 MERCURY POLLUTION PREVENTION TASK FORCE

2.1 Background and Overview of Preliminary Activities

The Michigan Mercury Action Plan includes the following charge to convene a Michigan Mercury Pollution Prevention Task Force:

"On the state level, the Director of the MDNR will convene a Mercury Pollution Prevention Task Force consisting of personnel from various state agencies, environmental advocacy groups, universities, users of mercury-containing products such as the dental profession, and the regulated community, to examine and define effective pollution prevention measures. This task force will develop recommendations on public education for mercury pollution prevention. A campaign to inform the public of the requirements of the Battery Act, 1990 PA 20, as amended, is an example of the work which could be done by the Task Force. The Task Force should also examine the feasibility of phasing out mercury-containing consumer products such as electrical cells and switches."

The Task Force was formed with representatives from the recommended stakeholders in August, 1994. The Michigan Mercury Pollution Prevention Task Force, hereinafter, **M2P2 Task Force**, held thirteen public meetings between August, 1994 and February, 1996. Individuals representing state and federal agencies, academia and private industry conducted presentations at M2P2 Task Force meetings to provide the most up-to-date information on the various mercury initiatives underway (**Appendix C**).

This report will provide an overview of the M2P2 Task Force meetings, a summary of the efforts undertaken by the M2P2 Task Force and recommendations for future state and federal efforts to reduce environmental mercury contamination with an emphasis on pollution prevention. Early M2P2 Task Force discussions included defining pollution prevention.

2.2 Pollution Prevention (P2)

The M2P2 Task Force agreed that the definition of P2 included in the Federal Pollution Prevention Act of 1990 would be referred to as a general guideline. The M2P2 Task Force also agreed that a hierarchy of recommendations would be used with P2 being the first choice. Because of the ubiquitous and persistent nature of mercury, additional aggressive measures would also be considered such as recommendations for legislation to facilitate P2 efforts.

P2

**Pollution
Prevention:**

pollution at the source by any practice which reduces the amount of any hazardous substance, pollutant or contaminant entering any waste stream or otherwise released into the environment (including fugitive emissions) prior to recycling, treatment or disposal; and which reduces the hazards to public health and the environment associated with the release of such substances, pollutants, or contaminants.

*is the
reduction
or
prevention
of*

[Pursuant to 1990 federal Pollution Prevention Act,
Section 6602(b).]

Therefore, the pollution prevention focus is on multi-media environmental management that emphasizes “source reduction.” Any practice that reduces the contaminant from being generated, released, or the toxicity of the contaminant can be considered source reduction. Source reduction may be accomplished through an equipment or technology modification, process modification, reformulation or a redesign of products. Protection of natural resources through conservation efforts that include improving energy efficiency can also be considered pollution prevention.

The Pollution Prevention Hierarchy:

Under the 1990 federal Pollution Prevention Act, Section 6602(b), a national policy on the priority of pollution prevention activities was established:

- “1) Pollution should be prevented or reduced at the source whenever feasible;
- 2) Pollution that cannot be prevented should be recycled in an environmentally safe manner whenever feasible;
- 3) Pollution that cannot be prevented or recycled should be treated in an environmentally safe manner whenever feasible; and
- 4) Disposal or other release into the environment should be employed only as a last resort and should be conducted in an environmentally safe manner.”

(This hierarchy may need to be reevaluated concerning the recycling of mercury. For example, in 1991 Sweden’s parliament decided that all uses of mercury should be phased out by the year 2000. The Swedish EPA has also recommended that mercury not be reclaimed for recycling or reuse. They believe that the only feasible long-term solution is that mercury be stored permanently in a geological repository. The Swedish EPA believes that exporting the waste for recycling or final disposal in another country is not an acceptable option.)

The M2P2 Task Force focused on preventing the release of mercury into the environment since any additional mercury released into the environment can be available for methylation and subsequent bioaccumulation in the food chain.

“an ounce of prevention is worth a pound of cure.”

Implementing prudent pollution prevention measures will help protect the health of Michigan's citizens and wildlife and will reduce unnecessary risk to humans and the environment while avoiding the need for spending significant amounts of money to clean-up mercury in the environment. It is truly a common sense approach. In the words of Benjamin Franklin, “an ounce of prevention is worth a pound of cure.”

2.3 Michigan's Mercury Pollution Prevention Task Force Priorities

The M2P2 Task Force identified as many of the sources of anthropogenic mercury as possible and sought to develop effective pollution prevention strategies to reduce this pollutant in Michigan. The M2P2 Task Force reviewed appropriate strategies and prioritized them. The following are a summary of these priorities.



1.) Education and Outreach

The M2P2 Task Force achieved consensus on a fundamental point: education and outreach are key to the implementation of mercury use reduction and minimization of anthropogenic mercury released to the environment. The initial charge in establishing the M2P2 Task Force stressed the importance of education and outreach for mercury pollution prevention efforts. It was believed that the most effective way to identify and prioritize education/outreach activities would be to divide the Task Force into subgroups to focus on key stakeholders that are known to use mercury-containing products or devices.

Six focus subgroups were targeted:

- General Public
- Health Care
- Dental
- Electrical Users/Manufacturers
- Chemical Users/Manufacturers

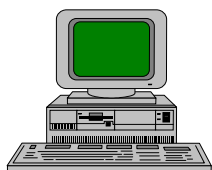
●Automobile

The list of the Education/Outreach Subgroup Members are included in **Appendix D**. The subgroups worked cooperatively with stakeholders keeping the following objectives in mind:

- 1) Educate Michigan businesses and consumers about the issue and options for reductions in use and/or releases;
- 2) Seek cooperative, voluntary efforts from Michigan's business community;
- 3) Promote collaborative efforts within Michigan's governing bodies (state, county, local) which work toward the above goals;
- 4) Solicit and promote efforts beyond Michigan's boundaries in furtherance of the stated goals.

One of the first tasks for each subgroup was to identify the mercury uses within their respective target group. For some groups this task was easier than others. Therefore, the status of the outreach effort will vary between the six subgroups. A detailed summary of the subgroup efforts are outlined in Section 3.0. The M2P2 Task Force recognized that numerous mercury efforts had already been initiated and noted the importance of not "reinventing the wheel". It was recommended that other state efforts such as Minnesota's and USEPA's efforts be followed and evaluated. The M2P2 Task Force brought in representatives from Minnesota Pollution Control Agency (MPCA) and USEPA-Great Lakes National Program Office (GLNPO) to provide an overview of their related activities. Emphasis was placed on not re-writing reports that already exist (such as the MESB mercury report). The following priorities were also identified:

2) Improve the quality of the inventory of mercury used and released in Michigan and establish databases of information on mercury.



The most up-to-date information on the sources of mercury used and released in Michigan are included in Tables 1.0-6.0 and Appendix B, respectively. The status of some inventory improvement and related recommendations are included in Section 5.0. It was decided that some data collection and implementation of the education/outreach priority implementation would occur simultaneously. Examples of data needed includes sediment, fish and human tissue monitoring data. Establishing baselines and identifying trends are critical to monitor success and progress. Information and data sharing could be done via the Internet system. Recommendations to implement this priority are included in Sections 5.2.5.

3) An evaluation of the current collection and recycling systems for mercury is needed in Michigan as well as spill clean-up information. Recommendations to implement this priority are included in Section 3.1.4.

4) Seek incentives for utilities to reduce mercury emissions.

It is widely recognized that electric utilities that burn fossil fuels, especially coal, are significant sources of mercury to the environment as a result of mercury being a natural element found in the fuel. An overview of the current activities being undertaken by Michigan utilities and recommendations for additional efforts can be found in Section 4.0 of this report.

5) Support mercury legislation.

Current legislation that addresses mercury in Michigan and suggested additional state legislation are included in Section 5.2.6 of this report. Recommendations for legislation at the federal level are included in Section 6.2. P2 is the preferred method of environmental management of mercury. Specific legislation was viewed as an important tool to ensure a quick response and to raise the awareness on the importance of phasing out the use of this toxic substance.

6) Continue state support of the initiated mercury P2 efforts.

The State needs to provide the necessary resources to continue the efforts initiated by the M2P2 Task Force. Specific recommendations on how many of these efforts could continue are included in both Sections 3.1.4 and 5.2 of this report.

2.4 Measuring Progress

The members of the M2P2 Task Force discussed, at length, the proper measurements of progress of a broad-based program of mercury pollution prevention or minimization. Given the nature of mercury itself, as well as its pervasiveness in the environment, this is a daunting task.

Measuring progress will entail quantitative assessments of both inputs and outcomes. For instance, measuring the amount of mercury eliminated in the production of automobile convenience light switches is, essentially, a measurement of an “input” to the pollution prevention effort. It is important, but it will not immediately correlate with improvements in the environment or human health.

Reduced levels of mercury in, say, human hair samples, fish tissue, or loons would certainly be hoped for “outcomes” or results of mercury minimization efforts. However, linking specific causes, in both temporal and spatial terms, to specific effects, is constrained by current scientific and modeling techniques.

The most reasonable approach is to measure inputs as an interim step while continuing to pursue long-term measurements of outcomes, for both the environment and human

health, to the extent current science and resources allow. Thus, the number of brochures printed and circulated; the amount of energy conserved; and the quantity of mercury eliminated from products and processes are examples of quantitative measurements of inputs. The MDEQ, MDPH and the PSC should track these and other recommended activities and measure their effectiveness of minimizing the presence of mercury or its emission into the environment.

At the same time, state and federal agencies should continue to develop and perfect better measurements of outcomes in terms of impact on the environment and human beings.

3.0 EDUCATION/OUTREACH SUBGROUP EFFORTS AND RECOMMENDATIONS



3.1 General Public Subgroup

This target group was viewed as all of Michigan's citizens, including school children. Because of the extra sensitivity of the fetus to methylmercury, the subgroup decided to place extra emphasis on expectant mothers. It was assumed the general public has little or no knowledge on the mercury issue.

3.1.1 Introduction

The primary mission of the general public subgroup was to identify, develop and recommend comprehensive mercury education/awareness information that encourages voluntary pollution prevention activities among the citizens of the State of Michigan. The objective of the awareness process is to develop an environmentally conscious public that is motivated to take personal responsibility for care of their environment. Individuals must think about not only the use of the product when purchased, but the disposal of the product when it is no longer wanted or when the life of the product is finished.

3.1.2 Sources and Alternatives

The table of consumer products known to contain mercury and associated alternatives is provided in **Table 1.0**. This table was extracted from the brochure entitled, "Merc Concern" developed by the General Public Subgroup (**Appendix E**).

3.1.3 Education/Outreach Current Efforts

The general public subgroup's efforts focused on the development and distribution of the Merc Concern brochure and traveling mercury displays. The state of Michigan received five mercury displays from the state of Minnesota. The MDEQ, MDNR, NWF, GEM Center - Houghton and Sault St. Marie Offices all obtained copies of the display for mercury P2 education/outreach efforts. USEPA - Region 5 provided funding to the Minnesota Pollution Control Agency to develop these displays for Minnesota, Wisconsin

and Michigan. The mercury displays provide an introduction to the mercury issue and include mercury-containing products and mercury-free alternative examples to view.

The general public subgroup developed the Merc Concern brochure to heighten the awareness and understanding of the environmental mercury concern and to help consumers make responsible decisions. The brochure is an awareness\educational tool that provides understandable information on mercury and alternatives to mercury-containing products. The M2P2 Task Force has and will continue to disseminate copies of the brochures to Michigan public and private associations, and special interest groups included in **Appendix F**. The M2P2 Task Force has also developed a "camera ready" copy of the brochure on computer disc that is also being shared with agencies for their own duplication and use.

The traveling mercury displays are available for use at such events as:

- Earth Day Events
- Water Quality Awareness Week
- Drinking Water Week
- State and County Fairs
- P2 Conferences and Workshops
- Neighborhood Meetings and Events
- National Safety Week (hospitals)
- County Household Hazardous Waste Collection Days
- Michigan Medical Society Annual Meetings
- Michigan Dental Association Meetings
- Science Teachers Association Meetings



1-800-662-9278
*for mercury
alternatives*

1-800 Phone Numbers

Both MDEQ and MDPH offer 1-800 phone numbers for citizens to call concerning mercury. Currently the MDEQ-EAD, through their Environmental Assistance Center, offer the 1-800-662-9278 phone number for citizens to call with questions regarding mercury alternatives. The MDPH offer the 1-800 MI-TOXIC phone number for questions on fish consumption or other health concerns. These 1-800 numbers have been included in the Merc Concern Brochure and should also be included in any additional educational literature developed.

Mercury Pilot Project

MDEQ-AQD staff sought and obtained a \$35,000 grant from the Saginaw Bay National Watershed Initiative (in the Office of the Great Lakes, MDEQ). Funding will be awarded to the Genesee County Environmental Health Department - Environmental Health Services Division located within the Saginaw Bay Watershed to conduct an education/outreach and collection program for mercury-containing wastes. On March

1-2, 1996 representatives of Genesee County Environmental Health Services Division and MDEQ-AQD assembled a “mercury P2” educational booth at the Michigan Science Teachers Association annual conference in Lansing, Michigan. Hundreds of science teachers were provided educational information on mercury P2 efforts (i.e. the Merc Concern Brochure) and were encouraged to share the information with their students. In April 1996, the Genesee County Environmental Health Services Division will provide three drop off sites for collection of mercury-containing wastes for proper management and disposal. This project will serve as a pilot for other Michigan counties to follow.

Case Study on Education/Outreach to the General Public - City of Detroit

Detroit's National Pollutant Discharge Elimination System (NPDES) permit requires the Detroit Wastewater Treatment Plant (DWWTP) to establish and implement a PCB/mercury minimization program to control and/or reduce the amount of PCB and mercury entering its sewer system. Subsequently, the Detroit Water and Sewerage Department (DWSD) targeted known sources of mercury, such as dental offices, hospitals, industrial laundry facilities and laboratories for waste minimization efforts. In recognition of the growing need to address the effects of hazardous substances from households on the environment, DWSD voluntarily extended its waste minimization efforts to include P2 awareness initiatives for households in its PCB/mercury minimization program. Recent studies have concluded that a significant proportion of some metals and organic chemical pollutants comes from residential sources.

To address pollution from the residential sector, DWSD initiated a Household Hazardous Waste (HHW) Program. The goal of the ongoing program is to develop an environmentally conscious public and to inspire within all individuals a sense of personal responsibility for the care of the environment. The HHW program began with a pollution prevention guide inserted with water bills to residential and business customers within the 123 communities it services in Southeast Michigan (approximately 4 million people!) The water bill insert is a two-sided 3x5 card that itemizes hazardous substances on one side, and lists the safe disposal, reuse, or recycling procedure on the reverse side. Additional educational media included environmental advertisements, pollution prevention pamphlets, coloring books and facts sheets that were developed and disseminated to neighborhood groups, educational institutions, libraries and inter-governmental agencies.

3.1.4 Recommendations for Future Efforts

The general public subgroup recommends the following future mercury pollution prevention efforts be undertaken to ensure the pollution prevention message does not terminate with the closure of the M2P2 Task Force. While lead agencies or associations have been identified; these groups should not work alone, but provide leadership for all stakeholders involved.



**General Public
Subgroup
Recommendations:**

1) The State of Michigan should

The following tools should be developed as part of the state-wide education/awareness campaign:

undertake an aggressive, comprehensive state-wide education/awareness campaign with strong support from the Governor to the lead agency to alert people on ways they can reduce mercury pollution.

Sufficient resources should be allocated to state agencies to implement this campaign. The Departments that would need to be involved include MDEQ, the Michigan Department of Education and MDPH. It is recommended that the MDEQ assume the lead at coordination and communication of state mercury outreach activities. The campaign should focus on specific target groups including, but not limited to:

- expectant mothers and women that intend to have children through WIC programs, county health departments, etc.
- anglers through fishing licenses and guides
- electrical contractors through associations
- children through science teachers

A. MDEQ should develop a mercury manual, involving all stakeholders. The manual will be used by the Environmental Assistance Center and copies should be shared with MDEQ district offices and Michigan county environmental health departments. Information, including an overview of mercury toxicity, known sources and alternatives, spill clean-up precautions and procedures, household hazardous waste and recycling centers that accept mercury-containing products and pollution prevention alternatives are examples of information that should be included in the manual.

B. MDEQ, involving all stakeholders, should develop energy conservation and energy efficiency material for distribution. The material should emphasize the link between reduced mercury emissions from reduced burning of fossil fuels from energy conservation and efficiency efforts.

C. MDEQ should develop a mercury concern video.

A general mercury video would be a useful tool that could be shared with local environmental groups, city and county environmental health departments. A video entitled, "Mercury Alert" developed by the State of Minnesota was viewed favorably by the general public subgroup. The general public subgroup recommends that a video specific to Michigan be developed.

D. Michigan's Governor, the Director of the Office of the Great Lakes, Director of MDEQ and the Director of MDPH should call upon retailers to voluntarily cease distribution of toys, games and clothing containing mercury.

E. Michigan Department of Education should develop a mercury fact sheet and/or video for science teachers.

Many elementary and high schools still use mercury in their science experiments. For example, the concept of density can be easily demonstrated by floating a steel ball on elemental mercury. The use of this mercury should be phased out. A video of this experiment could be developed and shared with others that use mercury, this would eliminate the need for mercury use by each science teacher. The phase out of other mercury uses in school chemistry labs (i.e. thermometers, demonstrations of barometric pressure) should be encouraged.

F. Michigan Department of Education should develop a mercury education/awareness component for school curriculum.

A mercury module could be incorporated into the "Pollution Prevention in Schools" Environmental Management Guide for Michigan School Districts funded by the USEPA, 1992.

G. MDPH should continue distribution of educational materials for women of childbearing age with regard to eating Michigan fish. This guidance should be updated regularly as appropriate to reflect current contamination levels and medical/scientific consensus on the health implications of mercury exposures. The MDPH currently publishes a fish eating guide for women of childbearing age (Appendix G).

2) Decentralize the education/outreach process. While a "coordinating" state agency is essential, the most effective way to conduct outreach activities is at the local level. The MDEQ should provide the necessary training and utilize the tools described above to continue this outreach effort at a local level. (The DWSD and the Genesee County education/outreach efforts described above could be models.)

The following tools should be used at a local level to educate the general public and help provide the means for environmentally safe disposal options.

A. County environmental household hazardous waste (HHW) collection programs should reprint the Merc Concern Brochures, use the mercury displays and provide for safe collection and disposal for mercury contaminated HHW.

B. Local environmental health departments should collaborate with local governments, public and private organizations, and grassroots organizations to raise mercury awareness in their community. The following organizations could be contacted to assist in supplementary mercury awareness efforts and initiatives:

- Ad Council (PSAs)
- Michigan Municipal League (Work with incinerator operators POTW operators)
- Michigan Education Association (Specifically Science Teachers Association and Math and Science Centers)
- Michigan Recycling Coalition
- Michigan Utilities
- Michigan Press Association
- Editorial Boards, Local Newspapers and Newsletters

- Library Associations
- Secretary of State
- Chamber of Commerce
- Michigan United Conservation Clubs

Local cities or counties could also use incentive programs. Beyond education and an appeal to public concern for the environment, incentive programs offering pollution prevention prizes can be useful for increasing public participation. Such incentives include:

- Merchandise discount coupons given with the original price of a mercury-free item.
- Instant prizes or rebates issued on the return of a mercury item.
- Free tickets to local events.

Local cities and/or counties should determine if specific outreach efforts need to be developed for special cultural communities, for minority or low-income urban and rural communities, or if educational materials need to be printed in a second language. Mercury has been used specifically for spiritual, medicinal and cosmetic purposes in certain Caribbean and Hispanic communities. The USEPA's Office of Pollution Prevention and Toxics has initiated an outreach activity to warn cultural communities that mercury use may be hazardous to the health of people engaged in a number of practices, some of which include the burning or sprinkling of elemental mercury in their home or automobile. The State of Michigan has a diverse population. To ensure education and outreach is extended to all communities, the need for a second language brochure or fact sheet should be determined and printed if the need exists.

3.2 Health Care Subgroup



The health care subgroup focused on the following stakeholders: hospitals, nursing homes, physician offices, (not dental), ambulatory care centers, HMO's, substance abuse treatment, veterinarian offices, and therapy centers. The health care industry has a wide variety of mercury uses including the familiar medical instruments such as mercury blood pressure devices (sphygmomanometers) and thermometers.

3.2.2 Introduction

Health care institutions have benefited from the declining trend of mercury use in the United States. As end users of various mercury products such as batteries and laboratory stains, the health care mercury use also declines as mercury is eliminated from these products and as manufacturers provide mercury-free substitutes. New environmental regulations are beginning to make a positive impact to reduce mercury in the health care industry. A scenario that is becoming a common occurrence in hospitals is that the local wastewater treatment plant (WWTP) is targeting the local hospital as a major industrial pollution source and setting strict wastewater mercury concentration limits. To ensure that these limits are being met, the WWTP conducts wastewater sampling. Often the

institution must pay for these tests and the WWTP may also require the hospital to arrange for additional testing. Such testing of wastewater pollutants is not new. Many facilities have been testing their wastewater for the presence of heavy metals such as silver, for biological oxygen demand (BOD), etc. for years, but only recently have these tests included mercury, and recently the permissible discharge concentration has been lowered. In fact, some local treatment plants are requiring effluent to be free of all detectable levels of mercury. This is typically 0.002 ppm, but the effluent limits can even be as low as 0.0002 ppm (i.e. 0.2 ppb).

Health care institutions that have been faced with documented high levels of mercury in their wastewater have had to conduct thorough investigations to identify the sources of their mercury. These investigations have contributed greatly to our current knowledge of the various products that contain mercury. For example, one source of mercury contributing to the burden in the wastewater are laboratory chemicals. Histology (the study of human and plant tissues) stains seem frequently to be singled out as a major contributor. Histology labs are common users of mercuric chloride solutions. Although, mercuric chloride use in hospital labs is being phased out, it is still in use throughout the country. Historically, many other stains have contained thimerosal, a mercury preservative. New formulations of the stains are now made without mercury. Some pathologists have expressed a concern with the alternative products performance and have been reluctant to change.

When hospitals identify a mercury-containing product, they usually discontinue its use and if necessary, find a suitable substitute. In those cases where the process is essential and there are no suitable substitutes, some hospitals have started a rigid practice of collecting the spent mercury products and disposing them as hazardous waste via a licensed hazardous waste disposal company to ensure that they are not released into the sanitary sewer. Reducing mercury levels in wastewater can be immediately solved by just eliminating current use. However, the mercury used in hospitals over the years has collected in drain pipe traps, crevices between floor tiles, and many other hard to identify locations. Several hospitals have reported success in lowering their wastewater levels after cleaning out their traps. This process is costly and time consuming. After conducting such a cleaning program, the hospital must be careful not to reintroduce mercury into the wastewater system.

The hazardous waste regulations and the growing awareness of employees and public to the hazards of chemicals has led to perhaps the second major mercury issue that health care institutions have faced which has been instrumental in catapulting hospitals into voluntary mercury reduction efforts. This is the issue of mercury spills. One small spill of mercury in a carpeted patient room can become a major challenge and result in a highly publicized costly cleanup operation. Health care institutions are to be commended for their environmentally sound responses to these incidents and for their subsequent conscientious response to plan for and prevent such incidents in the future.

The health care industry is highly regulated. One standards setting organization, "The Joint Commission for the Accreditation of Health Care Organizations" has required hospitals to maintain safety committees that meet every other month which, among other things, address hazardous material/waste management. Many hospitals have introduced

the issue of mercury spills and mercury P2 at their safety committees and have begun voluntary efforts to reduce the frequency of such spills and ensure that any future spills are appropriately handled. Often the plan for corrective action includes evaluation of mercury use in the hospital and elimination of all non-essential uses of mercury.

To the credit of the health care industry, whenever the topic of mercury P2 has been introduced to health care personnel, including the virtual elimination of all sources of mercury in hospitals, the suggestions have been met with very eager and favorable responses. Many hospitals have already started mercury P2 efforts such as switching to the non-mercury aneroid type sphygmomanometers, or eliminating the practice of using mercury thermometers and sending them home with the patients. Some smaller hospitals are reluctant to replace their sphygmomanometers due to the capital costs for replacement.

To a lesser extent, the issue of mercury air emissions has been addressed. Mercury vapor emissions from a spill of free mercury are often quickly controlled by proper spill clean up techniques that are designed to clean up the mercury spill promptly and completely without employee skin contact or inhalation exposure. Hospitals have also only just begun to address mercury vapor emissions from disposed mercury lamps. Several Michigan hospitals have contracted with disposal companies to collect their spent mercury lamps in an environmentally safe manner. One company will take the lamps and process them to recycle almost the entire lamp. Additionally, several hospitals collect and recycle their batteries through environmental service contractors.

There are fewer and fewer health care institutions with operating incinerators. For example, all but one medical waste incinerator in the Upper Peninsula have been shut down. A conservative estimate is that less than half of the hospitals in Michigan still operate an incinerator. An attempt is currently being made to verify the number of currently operating medical waste incinerators in Michigan (See Section 3.2.4). At this time, medical waste incinerators do not have any mercury emission control devices. They may soon be required to operate with mercury controls following promulgation of USEPA's medical waste incinerator regulations. The proposed schedule for promulgation of federal emission standards for medical waste incinerators is Spring of 1996.

The health care subgroup feels that the best way to address the issue of mercury air emissions is to practice appropriate pollution prevention efforts and ensure that mercury-containing items are not part of the incinerator waste stream. Such P2 programs may require significant initial educational and program implementation efforts, but are expected to be successful if the mercury load in the waste stream is eliminated by replacing mercury-containing devices and products with mercury-free alternatives.

An important consideration for education is ensuring that staff understand that mercury waste is different than regulated medical waste (i.e. red bags and sharps containers). The handy, leak-proof red sharps container can easily become the recipient of a broken thermometer by a "conscientious" nurse that does not fully understand the implications of his/her actions. At this time, regulated medical waste is almost always incinerated, and thus any mercury-containing items placed in the waste would be incinerated and the mercury volatilized and released into the atmosphere. Historically, some red sharps

containers were found to have mercury in the red plastic that was used to manufacture them. This problem was identified several years ago and has since been corrected.

Incidental mercury disposal in solid waste landfills has been addressed by larger health care institutions where these items are collected and disposed of properly as hazardous waste thereby avoiding disposal in a solid waste landfill. Smaller health care institutions that are classified as conditionally exempt small quantity generators of hazardous waste are exempt from the hazardous waste regulations. These smaller hospitals may not have any policy or procedures in place to identify mercury-containing wastes and they may continue to dispose of these materials in the solid waste stream.

3.2.3 Sources and Alternatives

One of the tasks of the health care subgroup has been to identify and compile all known sources of mercury in the health care setting. The compilation of this list was begun in 1994 through a joint effort of the Michigan Health and Hospital Association (MHA) and the MDEQ-AQD. The list was greatly enhanced and has since been continually updated by the DWSD. This list was used by USEPA for development of a special educational brochure produced by the Terrene Institute under a USEPA grant. The goal of this brochure is to educate health care industry representatives on the environmental hazards of mercury and to promote mercury pollution prevention efforts. A list of the identified sources of mercury in the hospital and the known alternatives can be found in **Table 2.0**.

As a result of the numerous mercury uses in hospitals, medical waste incinerators can emit a significant amount of mercury. In Michigan, the current estimate is approximately 1,000 pounds of mercury per year.

“Many of the current uses of mercury were identified to have known acceptable non-mercury substitutes.”

After the initial list of mercury-containing devices/products was compiled, the group discussed what items, if any, would constitute essential uses of mercury. A use was considered essential if no feasible mercury-free alternative was commercially available or if a similar performance could not be met by an alternative device or product. Many of the current uses of mercury were identified to have known acceptable non-mercury substitutes. For example, there are now mercury-free batteries, such as zinc-air batteries that can replace some of the mercury-containing batteries.

The Rayovac Corporation provided the health care subgroup with a list of all possible mercury-free substitutes and an identification of the few medical uses of mercury batteries, which currently do not have an acceptable, non-mercury replacement. However, several hospital representatives stated that they were able to find mercury-free batteries for all battery applications in the hospital. The mercury-containing spent batteries, now, by Michigan Law, have to be disposed of as a regulated hazardous waste. Batteries are covered in greater detail in Section 3.4.2.a.

Another mercury use that was reviewed as to whether or not it constituted an essential use was the use of mercury in sphygmomanometers. There is literature supporting both the discontinuation of mercury blood pressure devices and literature defending their continued use. However, the health care subgroup determined through interviews with

health care personnel that the reliance on mercury-containing sphygmomanometers was often a result of personal preference as opposed to equipment performance.

One use that is not unique to health care that was deemed essential was the use of mercury in fluorescent lights. The benefits for continued use of these lamps is well documented as evidenced by the success of the Green Lights program in promoting retrofitting of conventional mercury lamps in commercial buildings with the more energy efficient mercury lamps. Additional discussion on the management of fluorescent lamps is discussed in Section 3.4.2.d.

3.2.4 Current Efforts

In addition to the effort the subgroup spent on identification of the sources and alternatives available for the health care industry, the subgroup also spent a significant amount of time on the planning and development of specific educational tools including a brochure and discussions of an educational seminar focused on mercury P2 efforts in the health care industry.

The Michigan health care subgroup was one of the key groups that provided USEPA with information and review of the brochure that was developed by the Terrene Institute under an USEPA grant. The MDEQ-EAD working in cooperation with the MHA will distribute these brochures to Michigan hospitals, nursing homes and doctor's offices. The MHA, as well as several members of the health care subgroup including hospital representatives, purchased additional Terrene brochures for their own distribution, to enhance the educational impact of the Terrene brochure.

Mercury P2 Health Care Grants

The health care subgroup member from the National Wildlife Federation (NWF) successfully pursued a grant from the USEPA to conduct a mercury awareness/pollution prevention seminar(s) for the healthcare industry. The NWF plans to utilize the established health care subgroup to also serve as a seminar program planning committee. The MDEQ-EAD and the MHA intends to fully support and co-sponsor the mercury seminar with the NWF. MHA staff support for the mercury pollution prevention efforts had been approved and funded in December 1994 and will continue through December 1995 and the foreseeable future. The seminar is expected to take place in July of 1996.

The MDEQ representatives of the health care subgroup pursued and received a grant from USEPA - Region 5 to conduct an education/outreach effort toward facilities that operate medical waste incinerators (MWIs). The first objective is to identify the currently operating MWIs followed by a focused education/awareness program to help MWIs identify mercury P2 alternatives and proper disposal of mercury-containing wastes.

Case Studies of Mercury Pollution Prevention Measures in Health Care Institutions (A table summarizing these case studies is included in **Table 3.0**)

As part of the compilation of the draft report by the health care subgroup of the M2P2 Task Force, staff of Alpena General in Alpena, Bronson Hospital in Kalamazoo, Butterworth Hospital in Grand Rapids, Corning Clinical in Wyoming, Riverside

Osteopathic Hospital in Trenton, University of Michigan Medical Center in Ann Arbor, Genesys Health System in Flint and Henry Ford Hospital in Detroit were contacted regarding the topic of mercury pollution prevention measures currently underway in their institutions. While there are measures that must be adhered to under federal and state laws, for example training on spill prevention and management, many of these health care institutions go beyond mere compliance with existing law by educating a broad spectrum of employees in the proper procedures in handling mercury spills and minimization of mercury use. The following are examples of some of the ongoing activities.

1. Alpena General Hospital

Alpena General began instituting mercury pollution prevention measures approximately eight years ago by adopting a purchasing policy that eliminated mercury-containing items such as thermometers and sphygmomanometers. In addition, the institution purchases only mercury-free batteries from suppliers, and items such as thimerosal-free saline solution are being used.

Alpena's laboratory conducted its own study on mercury in solvents to determine where mercury was originating in their water discharge. It was necessary to follow this procedure because Material Safety Data Sheets might not list mercury in a solvent if amounts are too small or if the formula is protected. Alpena's laboratory then contacted their suppliers and requested that mercury-free solvents be supplied. Wastes generated within the institution are separated, and disposed of according to regulations. The institution has a policy on spill prevention and management in case of mercury spills or leakage.

Alpena provides an ongoing education and consultation with those departments directly involved in mercury pollution prevention, such as advising the nursing department to check for materials that may contain mercury, like thimerosal-containing saline solution. (For additional information call Ron Borke at 517-356-7390)

2. Bronson Hospital, Kalamazoo

Bronson Hospital found that educating the staff regarding the proper use of mercury-containing devices and spill clean-up procedures has helped to decrease mercury in their water discharge. Bronson Hospital formalized a policy to ban the purchase of mercury-containing items, where alternatives exist. In areas undergoing remodeling, sphygmomanometers containing mercury are being replaced with aneroid devices.

Bronson is also working in conjunction with Kalamazoo's wastewater department to meet their mercury discharge limit of 5 parts per billion, and to further decrease their concentration to 3 parts per billion.

(For additional information call Paul Dubdeld at 616-341-7930)

3. Butterworth Hospital, Grand Rapids

Butterworth Hospital hired a local environmental consultant to devise a mercury spill response and disposal plan that will be safe and economical for the entire hospital.

Educational materials about mercury including the Terrene brochure, have been distributed to all hospital departments, administrative personnel and regional facilities. Butterworth Hospital has made a commitment to reach **mercury-free** status. They have instituted a purchasing department policy stating unless there is no suitable, mercury-free alternative, no mercury-containing devices are to be purchased. In order to speed the transition to mercury-free status, administrative approval has been given to replace all sphygmomanometers currently in use with aneroid devices. The obstetrics department currently no longer sends mercury thermometers home with new mothers.

Two new buildings that are part of Butterworth Hospital will open this year. Administrative groups managing these buildings have committed them to be mercury-free. (For additional information call Dan Stickles at 616-391-1801)

4. Corning Clinical Laboratory, Wyoming

Corning Clinical Laboratory has instituted a wide range of mercury pollution prevention measures to meet the city's strict water guidelines of 0.5 ppb. Corning Clinical isolated manufacturer contributions of mercury within its wastewater system by testing its list of reagents for mercury content. Manufacturers might not list mercury on their Material Safety Data Sheets because the amount is so small. Once the sources were determined, a formal mercury reduction policy to continually decrease mercury in its effluent, as well as evaluating mercury content of the reagents it purchases, was instituted. If the vendor cannot provide mercury-free reagents, Corning Clinical will locate a vendor that does or change methodologies to processes that do not involve mercury; if it is not possible to purchase mercury-free reagents, the waste is segregated. This policy was submitted to the laboratory and to the city, and is updated quarterly. For additional purchases that contain mercury and are required in the laboratory processes, the purchases are based on the standards of tests and the quality of the test results.

In addition, Corning Clinical separates their wastes and packages them for shipment to hazardous waste facilities. Test spigots are inserted into all laboratory drains to regularly test the wastewater being released. If the tests are above the limits, the drain traps are replaced, the material is handled as hazardous waste and an investigation begins to identify the source. Additionally, staff and employees at Corning Clinical are regularly updated on the mercury reduction program at quarterly meetings.

(For additional information call Niel Findley 616-538-6700)

5. Riverside Osteopathic Hospital, Trenton

Riverside Hospital is in the process of adopting a Mercury Minimization Plan. The Plan includes identifying sources of mercury, developing a spill management procedure, providing educational material to staff, and developing an action plan that sets up a timetable for implementing mercury pollution prevention measures.

Riverside Hospital has identified some mercury sources (i.e., thimerosal, mercuric chloride) and has investigated substitution of the products with mercury-free alternatives. Riverside has informally instituted a policy allowing only mercury-free devices to be used in the hospital, including thermometers, thermostats and sphygmomanometers.

They have discontinued using mercury-containing batteries, and substituted esophageal dilator tubes with those containing water. Riverside is investing in T-8 lamps with electronic ballasts that contain less mercury than previous lamps. A spill prevention kit was purchased for mercury cleanup.

(For additional information call Dave Smith at 313-676-4200)

6. University of Michigan (UM) Medical Center, Ann Arbor

As part of a MDEQ settlement agreement with the UM, the University agreed to implement several supplemental environmental projects. These projects include the recycling of mercury-containing fluorescent lights within UM Housing Division; developing an action plan to replace mercury-containing reagents and products at the University Hospitals; establishing a permanent pollution prevention specialist position, and developing and implementing programs to practice pollution prevention, waste minimization, and toxic reduction methods in teaching, research laboratories and facilities throughout the University. Laboratories within the University Hospitals are investigating whether or not laboratory procedures that contain mercury can be substituted for those that are mercury-free. However, laboratories are hesitant to switch procedures where the same effectiveness is not guaranteed. The pharmacy has successfully discontinued using mercury in any items they dispense. The incinerator ash is tested twice a year to detect mercury levels within the system. Additionally, all sphygmomanometers containing mercury have been replaced with aneroid devices.

The Terrene brochure was distributed to individuals within the UM Medical Center responsible for disposing and dispensing mercury-containing items as part of an educational focus. UM Hospitals utilizes a mercury vacuum as appropriate during spill response activities. (For additional information call Marilyn Dietrich at 313-764-4427)

3.2.5 Recommendations for Future Efforts

“The Task Force recommends the health care industry adopt a pollution prevention philosophy that embodies the spirit of source reduction in regards to mercury-containing products used in its facilities.”

The Task Force recommends the health care industry adopt a pollution prevention philosophy that embodies the spirit of source reduction in regards to mercury-containing products used in its facilities. In 1990, the federal Pollution Prevention Act marked the emergence of source reduction as national policy for all hazardous substances. Significant opportunities exist for this industry to prevent or reduce mercury pollution by instituting proactive measures such as those demonstrated by the above facilities. The range of opportunities to apply pollution prevention measures in the health care industry runs from alterations in purchasing practices, facility operations and raw material use to adopting formal, well publicized policies and conducting employee workshops and training sessions. We urge the management of all Michigan health care facilities to become leaders in mercury pollution prevention.

The healthcare subgroup also recognizes that if voluntary P2 efforts are not successful in reducing mercury in health care institutions, then legislation should be considered, including legislation that sunsets the sale of mercury products and devices in the health care industry, where feasible. Many hospitals are in the process of making the transition away from sphygmomanometers, esophageal tubes, thermometers and batteries that contain mercury to mercury-free products. The healthcare subgroup investigation revealed that, with the exception of fluorescent lights, there are virtually no uses of mercury (or mercury-containing products) within hospitals and health-care facilities for which an adequate non-mercury substitute does not exist. Additional exceptions to this may be certain specific uses of sphygmomanometers, batteries, lab stains and calibration equipment.

Because of the capital expense involved in replacing these products, a reasonable period of time should be allowed to make the transition to mercury-free products. However, once that period of time passes, it is in the interests of the health care industry to eliminate as many of the sources of mercury from their waste stream as possible to eliminate mercury releases into the environment.

Healthcare Subgroup Recommendations:



1. MDEQ working in cooperation with the Michigan Health and Hospital Association should send letters to all Michigan health care facilities encouraging the phase out of mercury-containing products/devices by continuing mercury P2 efforts while allowing for the exercise of judgment by health care professionals.

The health care subgroup did not identify any mercury-containing products that could not be either replaced or eliminated from the hospitals and health care laboratories, with the exception of fluorescent lights (see possible exceptions listed above). Those hospitals which have been successful in eliminating mercury from their wastewater have either gone completely mercury-free in their laboratory or are capturing the few mercury products still in use for proper hazardous waste disposal. One of the issues to be addressed when changing a laboratory procedure that may affect test results, is to educate the physicians about the advantage of phasing out the mercury-containing products.

When an institution begins such a mercury phase-out it is important that they notify individual departments to prevent purchase of a whole set of new mercury-containing products.

2. MDEQ and the Michigan Health and Hospital Association should continue the education outreach process with the health care industry. Hospitals, nursing homes and medical office buildings should be included in this target group.

Education for all health care professionals is important and should include physicians, nurses, housekeeping staff, incinerator operators, administrative staff, and individuals responsible for purchasing new equipment. Having all staff informed will result in an

effective holistic approach for eliminating the need and use of mercury in the health care setting.

The health care sector subgroup is enthusiastically supportive of the mercury pollution prevention educational efforts underway. The health care field is an industry that is constantly changing and is acutely aware of the need for continuing education. The Joint Commission for the Accreditation of Health Care Organizations also has standards and expectations for ongoing training in all areas of patient care and hospital operations with particular emphasis on safety and health.

3. Recommend that hospitals discontinue the practice of sending mercury thermometers home with newborns. Home use of mercury-containing thermometers often results in breakage. Numerous alternatives exist including digital thermometers or body sensor stickers.

4. MDEQ should evaluate veterinary clinic uses of mercury and encourage similar mercury P2 activities as in the human health care industry.

3.3 Dental Subgroup

3.3.1 Introduction



Dental amalgam is an alloy that results from the trituration of powdered silver, tin, and copper with elemental mercury which quickly hardens to a solid phase. Dental amalgams have been used as the main restorative medium in teeth for more than 150 years. It is a popular restorative material because it is extremely user friendly (the material can be easily manipulated and compensates for a variety of operator errors); it is relatively inexpensive as a restoration material; and it is the only material that can be used in areas of the mouth that can not be kept dry during filling replacement. It also resists destruction by oral fluids, ingested dietary substances, and under most circumstances resists physical crushing forces as well. To replace amalgam with any other material presently available may create an economic hardship on the portion of the public that needs fillings.

3.3.2. Sources & Alternatives

During the placement and replacement of dental amalgams, excess material is carved from the restoration, is evacuated from the mouth and enters the wastewater stream. In the case of replacing existing amalgams, dust and larger particles are liberated from the old fillings which also are expelled into the wastewater stream. Mercury is incorporated within the amalgam waste. Mercury is not readily available from dental amalgams once they are set. The fate of amalgam waste is either the sewer system, a landfill, or an incinerator. Scrap amalgam (excess material that was not placed in the mouth) is usually

collected in an air tight container in dental offices and sent to a reclaimer/recycler. The MDEQ-AQD estimates that dental amalgam preparation in Michigan results in approximately 60 pounds of mercury per year entering the waste stream (Appendix B).

Capture of Dental Amalgam

Because dental amalgam remains the material of choice for the majority of fillings, capture and disposal of the amalgam waste must be addressed. Several filtration devices exist to trap the amalgam at its source. "Low-tech" devices such as sieves and strainers, and "high-tech" devices such as sedimentation columns, centrifuges, and complete capture units are currently marketed. Even though a dental office may capture amalgam waste to prevent it from entering the wastewater stream, mercury can still be deposited into the environment if the captured amalgam is disposed of down the drain or discarded in the trash rather than being properly disposed. Proper disposal options include reclamation and recycling.

Alternatives to Dental Mercury Amalgam

(See Table 4.0)

Alternatives currently available to mercury amalgams include gold, ceramic, porcelain, polymers, composites and glass ionomers. The cold silver and gallium techniques are among the most promising currently in the developmental phase. While alternatives to mercury amalgam have been developed, these alternatives have very limited use for a variety of reasons. Some of these variables are the location of the defect in the tooth, the extensiveness of the defect, the location of the afflicted tooth in the mouth, the amount of stress placed on the filling, and the probability for contact with moisture during placement of the filling material. Amalgam use is favored over composite resins by differences in strength durability, ease-of-placement, and the lower cost between mercury amalgam and alternatives. Amalgams resist dissolution and wear better, require a less precise technique during placement, and are lower in cost. However, 0.6% of the general population may have some risk to mercury amalgams due to mercury sensitivity.⁵⁰



“Mercury use by the dental profession decreases each year due to an increased emphasis on prevention of dental decay.”

Mercury use by the dental profession decreases each year due to an increased emphasis on prevention of dental decay. Fewer fillings are removed now than in previous years, and this trend is likely to continue. It has been suggested that with the technological progress being made in amalgam substitutes, these will become competitive and would likely displace traditional amalgam within

the next decade or two. However, since the general populace already has a great number of dental amalgam restorations in their teeth, the amalgam discharge into the waste stream will remain a challenge for some time.

3.3.3 Current Efforts

Despite the fact that mercury from dental amalgam is liberated in only small amounts over extremely long periods of time, the dental waste does add to the anthropogenic burden to the environment. In order to diminish future additions, all point sources need to be identified and work practices modified to minimize discharge to the environment. As one user of mercury, the dental profession has an interest in participating in the minimization effort.

DWSD has taken the lead in mercury minimization with the creation of a Task Force to study the issues involved and propose remedialization. Bulk mercury is still being used in the preparation of dental amalgams by a small proportion (10-15%) of the dental community. The majority (85-90%) of dentists use precapsulated amalgam alloy. Measurement of the ratio of liquid mercury to amalgam powder is much more exact with the precapsulated technique. Consequently, spills and other forms of liquid elemental mercury discharge are greatly diminished. A resolution submitted to the 1995 House of Delegates of the MDA was approved to recommend dentists replace the use of bulk mercury with the precapsulated form. The DWSD, MDA and MDEQ-EAD have worked to develop a bulk mercury collection program for a limited six-month period from January 1996 to June 1996, whereby those offices with residual bulk mercury may turn in unused bulk mercury rather than having it discharged to the environment. News bulletins and oral presentations throughout the state of Michigan will urge conversion of those offices still with bulk mercury to use the precapsulated form and offer to collect the unused bulk mercury.

Recruitment of dentists to participate in mercury waste minimization requires a broad campaign to enhance awareness of the problem. A pamphlet entitled, "AMALGAM WASTE REDUCTION AND RECYCLING" has been prepared by the Michigan Dental Association and was distributed to the membership at its annual meeting May 5-9, 1995 (**Appendix H**). Educational material has also been disseminated to readers of the *Michigan Dental Association's Journal* in the June 1995 issue.

The DWSD's Task Force for Mercury Minimization From Dental Facilities was established during 1994 to reduce mercury discharge into the Detroit sewerage system. Subcommittees were established that include:

- **Collection and Elimination of Bulk and Raw Mercury at Dental Offices**

This group identifies dentists still using bulk mercury sources and urges the discontinuance of this practice; identifies manufacturers and distributors and targets these facilities for a phase-out of this practice and considers the development of possible regulatory controls, if necessary. The bulk mercury collection program referenced above was designed and implemented by DWSD.

- **Collection and Disposal of Captured Amalgam**

This group is responsible for examining the incentives and barriers which exist that would impact establishing either a private or public program for the collection and safe, proper disposal of amalgam waste from dental offices.

- **Education and Outreach**

This group is responsible for the development of a program to distribute information to dentists on recommended approaches for capturing mercury, and the safe procedures for collection/disposal. This group also implements a variety of educational outreach activities, such as preparing brochures, assisting with employee training seminars for MIOSHA, providing news bulletins as part of the major health care providers' newsletters, developing oral presentations for the district dental societies' meetings, preparing material for publication in the dental industry's journals, and other related technical periodicals and video tapes.

- **Evaluation of Current Capture Systems and Future Mercury Controls in Amalgam Captured Units**

This group will review available literature and documentation on currently available mercury capture systems to determine their effectiveness, ease of use, availability, cost, etc. This group will develop a list of recommended, or approved systems for installation by Southeast Michigan dentists.

- **Research**

This group is responsible for reviewing new regulations and relevant literature.

The DWSD Task Force has examined the mercury pollution minimization plans of other areas such as Seattle, Washington, Minnesota and Sweden. This effort continues to reduce discharges of amalgam waste to the Detroit wastewater system.

Insurance companies are addressing mercury pollution prevention by working in conjunction with other organizations dealing with the same issues, such as the MDA and DWSD. Blue Cross/Blue Shield will include news bulletins provided by DWSD's Task Force for Mercury Minimization in their regular mailings to dentists. These mailings will assist in education efforts to dentists not affiliated with MDA. The Delta Dental Plan of Michigan and Dental Care Network are also participating in this project.

3.3.4 Recommendations for Future Efforts

Through careful analysis of the issues associated with mercury in the dental field, the dental subgroup makes a number of recommendations. Consistent with the definition of pollution prevention and source reduction, the most desirable solution is to find substitutes to replace mercury use in the dental office.

Dental Subgroup Recommendations:



1. Encourage development and the use of dental amalgam alternatives which could eventually replace the use of mercury in dental restorations and obviate the need for sophisticated and expensive filtration systems and proper handling procedures. (The National Institute of Health's Dental Research Institute is needed to stimulate research funding; the American Association of Dental Schools should emphasize alternate materials in educational programs and continuing education efforts to facilitate laboratory to clinic transfer of research and new materials by the Michigan Dental Association is needed.)

2. The M2P2 Task Force calls upon all Michigan dental offices to eliminate the use of bulk mercury. A ban on the use of bulk elemental mercury for use in dental amalgams would be consistent with the MDA's recommendation against its use. A state-wide collection program for bulk mercury from dental facilities should be established.

This will help facilitate elimination of bulk mercury from circulation and decrease the likelihood of spills. The fact that one collection campaign will occur in 1996 does not necessarily ensure that all bulk mercury in the community will be collected, and additional collection strategies should be planned.

3. The American Dental Association, Michigan Dental Association and Michigan Schools of Dentistry should increase education among dental personnel about proper dental amalgam waste collection and disposition.

Continue distribution of the MDA's "Amalgam Waste & Recycling" pamphlet as well as the "Merc Concern" brochures. Education should focus on the importance of proper collection and disposal to decrease amalgam in the wastewater stream. The fact that mercury may be captured in the filtration system does little to ease mercury pollution in the waste stream if recycling or proper disposal methods are not employed.

4. The MDEQ and the Michigan Dental Association should use DWSD's effort to reduce discharge of mercury waste from dental facilities as a pilot for the rest of the state to follow. An evaluation of this current program would first be helpful in learning what was most effective.

5. The MDEQ and the Michigan Dental Association should encourage insurance companies to develop payment plans which include competitive coverage for alternatives to dental amalgam. Insurance payment for alternative filling materials will stimulate incorporation of these materials into treatment plans making their use more widespread. Costs may well decrease over time as the importance of the alternate materials stimulates industrial research and development. (Blue Cross/Blue Shield and Delta Dental Insurance Co.)

6. The MDEQ and the Michigan Dental Association should develop and implement an amalgam waste tracking system. Future generators of amalgam waste should be identified according to those who use amalgam in their practice. Those that utilize mercury in their practice should participate in a system of tracking captured waste amalgam to reclamation centers.

7. The Michigan Dental Association should encourage the American Dental Association or the International Standards Organization and the National Sanitation Foundation to conduct efficiency testing on the systems marketed for the capture of waste amalgam. Evaluation of these systems should be performed by an impartial testing agency and the results disseminated to the profession. This could be done by an organization such as the American Dental Association in a manner analogous to their testing of therapeutic agents.

8. The National Institute of Dental Research, the American Dental Association and dental manufactures should conduct additional research on restorative material alternatives and also capture technology for dental amalgam waste.

- Research on amalgam filling alternative should be stimulated in order to develop alternative filling materials whose physical properties, ease of utilization, and cost would increasingly approximate those of dental amalgam.
- Research is needed to characterize the nature and fate of mercury (free elemental vs. amalgamated mercury in the waste stream and related risks) as well as the quantity transported from the dental unit to the in-street sewer line.
- Efforts should be made to recruit those industries with financial interests and expertise in capture technology in order that capture systems with increasing efficiency and smaller cost can be developed. Refinements over time should result in a capture system where discharge approximates zero.
- The International Standards Organization should be encouraged to develop standards for amalgam separation technology so that independent agencies can test amalgam capture units to determine degree of efficiency.

3.4 Electrical Users/Manufactures Subgroup

3.4.1 Introduction

The United States Bureau of Mines has identified three categories of electrical devices that utilize mercury. The Bureau reports annually on the usage in each category. The categories are batteries, light bulbs, and switches. Each category is considered separately in the following discussion because each presents its special set of pollution prevention opportunities.

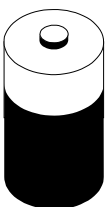
(See **Table 4.0** for mercury uses in electrical applications and alternatives)



BATTERIES

3.4.2.a. Sources and Alternatives

Historically, mercury has been used in alkaline-manganese and zinc-carbon batteries to control the evolution of hydrogen gas.⁵¹ Over the last decade, the U.S. battery industry has achieved a 99% reduction in the amount of mercury it utilizes. Approximately 6 tons of mercury was utilized in the manufacture of batteries in 1994, the most recent year on record.⁵² Alternate manufacturing techniques and alternate materials have nearly eliminated the need to add mercury to batteries. A possible exception is the continued need in specialty batteries used in hospitals and military applications. These batteries cannot readily be replaced without altering, at considerable expense, the equipment they power. Many hospitals have replaced all of their mercury batteries with mercury-free models.



“Many hospitals have replaced all of their mercury batteries with mercury-free models.”

3.4.3.b. Current Efforts

In addition to accomplishing the previously mentioned 99% reduction in mercury use, the U.S. battery industry, through the National Electrical Manufacturers Association (NEMA), is endorsing legislation to prohibit mercury use in all but the specialty medical and military batteries. This legislation also commits the industry to provide recycling and disposal of the few medical and military batteries still being manufactured. The legislation will ensure that all national and foreign manufacturers similarly avoid use of mercury in batteries. Such legislation has been passed in Michigan (see Section 5.1) as well as a handful of other states, and is expected to soon be passed at the federal level.

3.4.4.c. Recommendation for Future Efforts

The work that has been done to remove mercury from virtually all newly manufactured batteries has left a continually declining amount of mercury from previously manufactured batteries. NEMA reports that between 1989 and 1993, U.S. manufacturers stopped using mercury in all but the exempted specialty batteries. The cessation of use spanned four years because different batteries and different manufacturers had varying schedules. The M2P2 Task Force has considered whether there should be bans on the disposal of batteries in incinerators. Putting aside the important consideration of the costs of such bans⁽²⁾ and the extent to which pollution control equipment can remove mercury in previously manufactured batteries, and only considering the timing of such an initiative, there does not appear to be merit in such a ban. The earliest a recommendation from this Task Force could be acted on and enacted into law would be the summer of 1996. By that time, there will be an exceedingly small amount of mercury left in the battery inventory.

Electrical Users/Manufactures Subgroup Recommendations:

1) MDEQ should continue mercury P2 education and outreach efforts by informing users of the various types of batteries that contain mercury and provide information on alternatives and recycling centers. A summary of the various types of batteries and known mercury content including alternatives and location of recycling facilities should be part of the information that is available through the Environmental Assistance Center. Additionally, information should be provided on the new battery law that bans the sale of specific types of batteries containing mercury after January 1, 1996.

² In February 11, 1991 *Federal Register* preamble to a rule making on municipal incinerators, EPA stated, "...the Agency finds that it has not been shown that battery separation programs have a sufficiently significant effect on mercury emissions to warrant their inclusion as part of a national standard at this time."

2) MDEQ should ensure that battery manufacturers comply with Michigan's new battery law. This law requires manufacturers to identify mercuric oxide battery collection sites, informs the purchasers of the collection site and informs the purchaser of a telephone number that the purchaser may call to get information about returning mercuric oxide batteries for recycling or proper disposal (see Section 5.1).

LIGHT BULBS

3.4.2.d. Sources and Alternatives (See Table 5.0)

Mercury-containing lights include fluorescent lights and high intensity discharge (HID) lights such as mercury vapor, metal halide and high pressure sodium (HPS) lights. Twenty-seven tons of mercury were utilized in fluorescent and mercury vapor light bulb manufacture in 1994.⁵³ The mercury in fluorescent lights acts as multiphoton source. Ultraviolet light is produced by mercury when it is bombarded by electrons produced by current flowing through the tube. Phosphorus powders coated on the inside glass tube convert the ultraviolet light to visible light.⁵⁴ There are no economically feasible alternatives for mercury in fluorescent lights, although the quantity required for operation continues to decline. Although manufacturers are expected to continue to strive toward reducing the mercury content, fluorescent light usage is expected to continue to increase. In Michigan, the estimate of mercury emitted into the atmosphere from fluorescent light is approximately 330 pounds of mercury per year. The contribution of mercury entering the waste stream from improper disposal of fluorescent lights is estimated to be approximately 2,200 pounds of mercury per year. The contribution of mercury from the disposal of HID lights in Michigan is unknown. Numerous uses of HID lights in Michigan are known. For example, an article in the *Grand Rapids Press*, November 27, 1994 stated that mercury vapor lamps will be placed every 60 feet in the tunnel between Sarnia, Canada and Port Huron, Michigan.



The mercury vapor in fluorescent and HID lights, together with other aspects of light manufacturing, gives these bulbs high energy efficiencies that have not, to date, been attained in any comparable bulb design. Typically, these lights are 3-4 times more energy efficient than incandescent lamps. The USEPA has endorsed these lights in their Green Lights program (see Section 5.2.2), recognizing the benefits they provide in

reducing energy demand. Because less energy is required less fossil fuel is burned that naturally contains mercury, thereby reducing mercury emissions.

3.4.3.e. Current Efforts

While there is no ready alternative to the use of mercury in these lamps, there does appear to be the possibility of reducing, to an extent, the amount of mercury in each lamp. Fluorescent lamps originally contained about 40 milligrams of mercury. NEMA claims that the average fluorescent light bulb today contains about 20 milligrams of mercury and that the very newest light bulb manufacturing plants are able to produce lights with only 15 milligrams of mercury without affecting product performance. The more precise application of various coatings is allowing the more modern plants to utilize less mercury per bulb. USEPA Region 5, however, has not yet concurred with NEMA's claim of reduced mercury usage and has been asked by the M2P2 Task Force to provide their perspective on the extent to which the mercury content of lights has declined.

Federal Proposal for Lamp Management

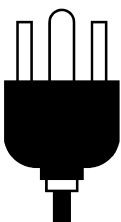
In November 1994, the MDEQ Air and Water Chiefs submitted a letter to USEPA on the proposed rules for the management of mercury-containing lamps (*Federal Register* vol.59, 7/27/94). They supported the option which would require recycling of mercury-containing lamps, they did not support the option of a conditional exemption to allow the disposal of the lamps in municipal waste landfills. They recommended that the lamps should either be included in the "universal waste rule" under subtitle C of Resource Conservation and Recovery Act (RCRA), or if exempted from that rule, regulation under subtitle D of RCRA should be conditional upon the lamps being recycled. The USEPA has not acted on this proposal.

Universal Waste Rule (UWR)

The final UWR was published FR vol. 60, No. 91, May 11, 1995. This final UWR rule streamlines the hazardous waste management regulations governing the collection and management of batteries, pesticides and thermostats. However, USEPA did not include fluorescent lamps in the final UWR. The UWR "will greatly facilitate the environmentally-sound collection and increase the proper recycling or treatment" of the waste classified as universal. "The current RCRA regulations have been a major impediment to national collection and recycling campaigns for these wastes. This rule will greatly ease the regulatory burden on retail stores and others that wish to collect or generate these wastes." "A petition process is also included through which additional wastes could be added to the UWR regulations in the future" [FR vol. 60, No. 91, 5/11/95. p. 25492]. USEPA is allowing states the flexibility to add additional waste, such as mercury lamps, to their state list of universal wastes without requiring the waste to be added at the federal level [FR vol. 60, No. 91, 5/11/95. pp. 25510-25516].

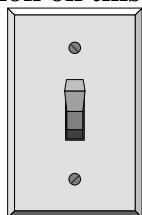
In October 1995, MDEQ-WMD proposed revisions to its hazardous waste rules to adopt the UWR (Administrative rules to Part 111 of NREPA, 1994 PA 451, as amended.) MDEQ-WMD has proposed the inclusion of thermostats, batteries, banned pesticides and mercury-containing lamps as universal wastes.

The disposition of fluorescent lights is regulated by USEPA under the RCRA. There are at least four regulatory alternatives presently before USEPA. Individual states can revise their state regulations, but RCRA requires states to have regulatory programs at least as stringent as USEPA's federal rules. The four alternate strategies before USEPA are: **1)** conditionally exempt fluorescent lights from Subtitle C, hazardous waste disposal rules; **2)** conditionally exempt fluorescent lamps from certain Subtitle C storage, transportation and recycling rules, but not from the Subtitle C disposal rules (i.e. the Universal Waste Rule); **3)** modify the toxicity characteristic leaching procedure (TCLP) test which is utilized to determine which wastes become Subtitle C hazardous wastes; or lastly, **4)** maintain the status quo. It is not known at this time what option USEPA will recommend.



3.4.4.f. Electrical Users/Manufactures Subgroup Recommendations:

- 1. MDEQ should work with lamp manufacturers and encourage their continued effort to reduce the quantity of mercury required for operation and encourage development of economically feasible alternatives with comparable energy efficiency ratings.**
- 2. MDEQ should continue to work with USEPA to encourage facilities to participate in EPA's Green Lights program.**
- 3. MDEQ should continue its effort on incorporating the universal waste rule (UWR) into Michigan regulations to include such mercury-containing wastes as thermostats, batteries, banned pesticides and mercury-containing lamps as universal wastes. Further, MDEQ should seek expansion of the rule to include mercury-containing switches, thermometers and mercury-containing medical devices to simplify the collection and recycling of these wastes. [In October 1995 MDEQ-WMD proposed revisions to update its hazardous waste rules and adopt the UWR (Administrative rules to Part 111 of NREPA, 1994 PA 451, as amended. MDEQ-WMD has proposed the inclusion of thermostats, batteries, banned pesticides and mercury-containing lamps as universal wastes.)] MDEQ should continue to track NEMA and USEPA's policy on the management of fluorescent lights.**
- 4. MDEQ should determine if fluorescent light barrel crushers are a significant source of fugitive mercury emissions to the atmosphere and develop a policy/recommendation on this process.**



"Electronic alternatives to these mercury-containing switches are currently available."

SWITCHES

3.4.2.g. Sources and Alternatives (see Table 5.0)

Seventy-nine tons of mercury were utilized in 1994 in the manufacture of switches.⁵⁵

Mercury is utilized in both

temperature or pressure sensitive switches and in mechanical or positional switches that are activated by a change from a vertical to horizontal position (mercury tilt switch). Examples of temperature-sensitive tilt switches include switches used in furnaces and thermostats mounted on a bimetal coil. Use of a pressure-sensitive tilt switches are often used in industrial applications, such as within a reactor vessel. Positional tilt switches are included in such applications as washing machine lids to shut off the motor or automobile light switches in the hood and trunk of some vehicles. In Michigan, the only estimate of the environmental mercury contribution that could be made from switch disposal was from automobile mercury switches. That estimate was between 190 to 240 pounds of mercury per year, see Section 3.6.2. Electronic alternatives to these mercury-containing switches are currently available. For

example, the electronic alternatives to thermostats are available and offer better temperature control, but at a higher cost. Consequently, a substantial portion of thermostats will continue to rely on mercury-containing switches. The useful life of thermostats is more than a decade. Even if mercury use in all newly manufactured thermostats ended, there would still be pollution prevention opportunities associated with the disposal of used switches.

3.4.3.h. Current Efforts.

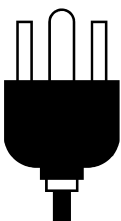
The M2P2 Task Force Chairman sent a letter to NEMA's President and a representative at the U.S. Bureau of Mines requesting information on electrical manufacturers. A preliminary list of mercury switch manufacturers was provided by the U.S. Bureau of Mines. Since this letter was received, additional information on manufacturers in Michigan has been obtained, but time did not allow for correspondence with these facilities. One of the most noteworthy M2P2 Task Force efforts underway in Michigan is the effort by the Michigan automobile manufacturers to phase out mercury switch applications as early as 1997, see Section 3.6.3.

As part of the *Binational Program to Restore and Protect the Lake Superior Basin*, a tri-state Lake Superior Pollution Prevention Team was created. The Team has developed recommendations and is currently implementing several programs focusing on zero discharge of nine pollutants, including mercury, to the Lake Superior Basin. The MPCA is the lead agency that is developing an educational/outreach campaign and collection program for products containing mercury and PCBs. The targeted campaign includes identifying stakeholders such as contractors and trade associations, promoting alternatives and setting up a collection network, and conducting a pilot collection. Technical assistance and promotional materials covers information on fluorescent lights and thermostats. The outreach materials have been shared among Michigan, Minnesota and Wisconsin in the Lake Superior Basin. The outreach materials include brochures titled, "Mercury in the Environment - the waste connection" and includes six separate colorful inserts on specific mercury-containing devices and recommended alternatives and disposal recommendations. The mercury-containing device information is for:

mercury-containing thermostat probes, fluorescent and high intensity discharge lamps, mercury switches and relays, mercury-containing thermostats, mercury thermometers and gauges, manometers, barometers and vacuum gauges. This material has been developed and outreach efforts were initiated in early 1996.

In the state of Minnesota, the Honeywell Corporation has established a reversed distribution network for thermostats and USEPA has facilitated the recycling of these mercury switches by exempting them from certain RCRA hazardous waste recycling rules (i.e. the Universal Waste Rule, see discussion in Section 3.4.3.e.). The recycling of thermostats is facilitated by the relatively large amount of mercury in these switches, the small size of the device, and the pre-existence of a distribution network, namely appliance repair shops.

3.4.4.i. Electrical Users/Manufactures Subgroup Recommendations:



1. MDEQ should contact switch manufacturers and users of switches including contractors and trade associations to improve the estimate for mercury switch use and disposal (i.e. in appliances such as furnaces and sump pumps) and explore opportunities for mercury-free alternatives. (Follow the example set by AAMA and the automobile industry to phase out the use of mercury switches in vehicles.)

2. MDEQ should encourage Michigan facilities to participate in the Honeywell Corporation's reverse distribution recycling program for mercury-containing thermostats.

3. The educational/outreach campaign and collection program for products containing mercury in the Lake Superior Basin should be extended to Michigan's lower peninsula by MDEQ.



Chemical Users/Manufacturers Subgroup

3.5.1 Introduction

The focus of this subgroup was directed at the voluntary P2 initiatives presently and successfully underway in Michigan's chemical industry. The primary source of information for this section was provided by the Michigan Chemical Council (MCC). MCC members recognize that, if not used and managed properly, certain chemicals can present risks to public health and the environment. Mercury P2 efforts should be aimed at incidental and inadvertent release of mercury by companies that utilize municipal wastewater treatment facilities. Water quality based regulations on mercury in wastewater are becoming more stringent and require that mercury levels in treated wastewater be reduced to well below currently accepted analytical detection limits. According to USEPA's TRI database, the chemical industry in Michigan had no mercury emissions to the environment since such data was collected. The reporting threshold for Mercury is 10,000 pounds (USEPA TRI database, SIC code 28, Michigan, 1987-1993).

3.5.2 Sources and Alternatives

Although the Michigan chemical industry had no emissions of mercury above the threshold level of 10,000 pounds, established in USEPA's TRI database, the chemical industry has developed the Responsible Care® Initiative to address the public's concerns relating to mercury and other chemicals.

PRIMARY and SECONDARY USES OF MERCURY

| | |
|------------------------------|---|
| Primary Mercury Production | There are no mercury or by-product mercury mines in Michigan. |
| Secondary Mercury Production | There are none known in Michigan. |
| Mercury Compound Production | There are none known in Michigan. |

Chemical and Allied Production Uses

| | |
|-----------------------|---|
| Chlorine/Caustic Soda | No producing facilities in Michigan. |
| Laboratories | Mercury is used in the analysis for mercury itself, as a preservative and as a reagent in a variety of other laboratory procedures. It is also found in some laboratory instruments. Mercury is used in a wide number of environmental and health service laboratories in Michigan. |
| Paints | Phenylmercuric acetate (PMA) was used as a biocide to control mildew in latex paints. It has not been allowed for use since 1990 for interior paints and 1991 for exterior coatings. |

Other Products

fungicides,
pigments,

Mercury is used as a catalyst, or preservative in the production of certain plastics, pesticides, cosmetics, pharmaceuticals, disinfectants, dyes, explosives and fireworks.

3.5.3 Current Efforts

Significant reduction in mercury use within the chemical and allied products category has occurred between 1988 and 1993. The removal of mercury in paints and pesticides are prime examples of successful mercury reduction measures in the chemical industry.

Nationally in the chemical industry, mercury cell chlor-alkali plants are the single most significant user of mercury. Mercury in the production of chlorine and caustic soda, however, declined 45 tons in 1994 because of the conversion of several plants to membrane cell technology and increased onsite recycling of wastewater sludges. There are no mercury cell chlor-alkali plants in Michigan.

Water quality based regulatory requirements on mercury are currently requiring mercury pollutant minimization programs be carried out through industrial pretreatment programs run by several municipal wastewater authorities in Michigan. These effluent requirements are so stringent that wastewater discharges to municipal treatment works must be reduced to below levels of current analytical detection (0.2 micrograms per liter). Mercury has been detected in wastewater from health care facilities, laboratories, certain industrial users and dental offices. The current focus has been to work individually with these facilities to identify the source of mercury, if possible, and to reduce their mercury discharge through elimination of the identified sources or through improved waste management techniques (see discussion of state program in Section 5.1). This is a very resource intensive method of gaining small reductions in mercury use and discharge. The Great Lakes Initiative, and more sensitive analytical methods capable of detecting mercury at the level of the environmental concern, may extend the mercury minimization program requirements to a majority of Michigan municipalities. There is need for a more general, more efficient approach to mercury minimization in products and processes that may result in mercury being discharged to the water environment. The Health Care and Dental sectors are addressed in Sections 3.2 and 3.3 of this report.

Pollution prevention may well apply to reduce or eliminate certain laboratory uses of mercury. For example, mercuric sulfate is used in the COD (chemical oxygen demand) test. However, there are alternate test procedures, such as TOC (total organic carbon) and BOD (biochemical oxygen demand), that may satisfy the analytical need without the use of mercury. USEPA could evaluate whether the benefits of the COD test justify the use of mercury in the laboratory. The test could be eliminated or at least not required through the NPDES (National Pollutant Elimination System) permit program. Similarly, there are several different test methods for chloride, including the mercuric nitrate method, listed in Standard Methods For the Examination of Water and Wastewater. USEPA and/or the Joint Editorial Board for Standard Methods could be requested to review all methods utilizing mercury, to eliminate those for which there are acceptable alternative methods, and to otherwise reduce the use of mercury in the laboratory.

In 1990, the Chemical Manufacturers Association (CMA) launched the Responsible Care® Initiative, which requires each of CMA's members to continuously improve its performance in health, safety, and environmental quality. Responsible Care® is built around a set of ten Guiding Principles and six Codes of Management Practices that embrace all stages of a chemical's life cycle from initial research through recycling and disposal. Although each aspect of Responsible Care® is integral to the initiative's success, two Management Codes are particularly relevant for the M2P2 Task Force Report. These include the Pollution Prevention and Product Stewardship Codes. The MCC and its members participate in Responsible Care® through its Partnership Program and are working to implement the initiative in Michigan.

Pollution Prevention Code

The Pollution Prevention Code promotes chemical industry efforts to protect human health and the environment by reducing waste generation and pollutant emissions. In addition, the Code encourages sound waste management practices. The Pollution Prevention Code sets three far-reaching goals: long-term reduction in the amount of all releases to air, water, and land; continuous reductions in the amount of wastes generated at facilities; and responsible management of any remaining wastes and releases. To fully implement the Code companies must integrate pollution prevention into all aspects of corporate and facility-level planning. To date, MCC member releases of TRI chemicals have declined by approximately 45%.

One Michigan pharmaceutical firm routinely consolidates its laboratory mercury and recycles it to a commercial mercury reclaimer. In 1993, 176 pounds of mercury were sent in for recycling by the firm. The chemical industry is proud of its significant achievements and is committed to continuous improvement through Responsible Care®. The industry will continue to further reduce emissions and ensure chemicals and chemical products are managed safely.

Product Stewardship Code

The Product Stewardship Code is designed to make health, safety, and environmental protection an integral part of designing, manufacturing, marketing, distributing, using, recycling, and disposing of chemicals and chemical products. The Code promotes the safe handling of chemicals from initial manufacture to distribution, sale, and disposal. It emphasizes that everyone involved with the product must act responsibly to help maintain a safe and healthy environment.

State Government

The MDEQ-EAD recently developed a flyer on mercury in some aqueous cleaners. It presented facts surrounding the use of some aqueous cleaners containing caustic soda solutions. This informational flyer was used as an educational tool by MDEQ for industries that are known to use aqueous cleaners to draw their attention to this pollution prevention opportunity (**Appendix I**).

3.5.4 Chemical Users/Manufacturers Subgroup Recommendations:



- 1) The M2P2 Task Force recommends the Michigan Chemical Council undertake an assessment of the quantities and types of mercury used by the Michigan chemical industry and the voluntary pollution prevention methods being used to prevent releases to the environment and share with MDEQ for public dissemination.**
- 2) All stakeholders should be involved in the development of a national labeling requirement for products or components which contain a significant percentage of mercury for its function or as an added ingredient. This would allow consumers and businesses to make informed choices in efforts to support pollution prevention progress.**
- 3) Michigan should provide incentives to promote voluntary pollution prevention efforts. Many of these efforts have already been extremely successful. Incentives could include tax credits or grants that could be given to companies for pollution prevention training and education.**
- 4) Increase the dialogue with industry toward further voluntary pollution prevention initiatives. At the national level the Chemical Manufacturer's Association Responsible Care® program may be the appropriate avenue to bring more focus on mercury pollution prevention opportunities in the chemical industry. Ongoing involvement of the Michigan Chemical Council is encouraged at the state level.**
- 5) The M2P2 Task Force urges the continued effort by the MDEQ industrial pretreatment program staff to disseminate information to local pretreatment authorities and others on mercury-containing products and processes and opportunities for P2. (Program described in Section 5.1)**
- 6) The thresholds for mercury emissions under the Toxic Chemical Release Inventory (TRI) may need to be evaluated. This reporting threshold may be of questionable utility given that the present reporting threshold for mercury is 10,000 pounds per year and the Michigan anthropogenic atmospheric emissions are estimated to be between 8,000 - 10,000 pounds/year. TRI reporting is required by Section 313 of Title III of the 1986 Superfund Amendments and Reauthorization Act (SARA 313).**
- 7) The Michigan Chemical Council and MDEQ should work cooperatively at improving the inventory of mercury released into Michigan's environment from the**

Michigan chemical industry to improve the scientific base of knowledge in Michigan.

8) With the assistance of the manufacturing and chemical sectors the MDEQ should undertake more educational efforts on P2 efforts regarding mercury. The informational flyer on aqueous cleaners is a good example of what might be done (Appendix I).

3.6 Automobile Subgroup

3.6.1 Introduction

The automobile (auto) subgroup agreed to examine potential mercury use and P2 opportunities in automotive manufacturing facilities as well as in the products manufactured (i.e., cars, vans and light trucks). The auto subgroup decided to approach several organizational entities in an effort to examine both facility and product related questions. Those organizations identified for outreach were:



- Environmental staff at companies of the American Automobile Manufacturers Association (AAMA - Chrysler Corporation, Ford Motor Company and General Motors Corporation);
- Association of International Automobile Manufacturers (AIAM);
- Society of Automotive Engineers (SAE);
- United States Council on Automotive Research (USCAR); and
- Minnesota Pollution Control Agency (MPCA).

These organizations were selected for the following reasons:

AAMA - AAMA members represent the majority of automotive manufacturing facilities as well as vehicles registered in Michigan. For example, 1994 new passenger car registrations for Michigan were 422,179 (1995 edition of AAMA Facts and Figures). Registrations for the three AAMA companies represented nearly 89% of this total.

AIAM - AIAM members include virtually all other car companies who manufacture in or import to the U.S. Those companies include Honda, Mazda, Nissan, Toyota and others. Only Mazda has assembly operations in Michigan (Auto Alliance International, Inc. located in Flat Rock is a Mazda/Ford joint venture with manufacturing operations governed by Mazda).

SAE - In an effort to explore P2 opportunities at the design end of the automotive business, both for manufacturers as well as suppliers, it was decided to approach SAE.

SAE develops standards that are used by the design engineers in the development of new products. Exploring potential P2 opportunities through the standards process may be unique and may have application to other sectors as part of the M2P2 Task Force efforts. The SAE Design for Manufacturing and the Environment Committee was selected as the most relevant SAE committee to approach.

USCAR - USCAR is an umbrella organization established by Chrysler, Ford, and General Motors to conduct joint research. USCAR was chosen as a target organization for outreach because one of the research initiatives focuses on vehicle recycling, known as the Vehicle Recycling Partnership (VRP). One of the efforts within the VRP was the establishment of the Vehicle Recycling Development Center (VRDC) located in Highland Park, Michigan.

MPCA - MPCA was selected for interaction by the auto subgroup because of a study which they conducted on automotive shredder residue which included an assessment of mercury switches identified in connection with vehicles which are disposed.

To initiate discussions with AAMA members, AIAM, SAE and USCAR, the auto subgroup developed letters which were sent to these organizations by the M2P2 Task Force Chairman. The letters provided background on the purpose of the M2P2 Task Force and requested information on a series of questions related to mercury. A sample of one of these letters is shown in **Appendix J**. These letters have formed the basis for a series of meetings and/or conference calls with the respective organizations. While no letter was sent to the MPCA, a meeting and several conference calls were arranged. Results of interaction with all the targeted organizations are addressed in Section 3.6.3.

Within the timeframe and resources available, the auto subgroup determined the above organizations provided a sound basis for considerable outreach opportunities. Given the size and dimensions of the automotive sector, it is recognized that there may be other organizations, including those related to the automotive supplier base, that might be considered for future outreach efforts. However, within the timetable for the auto subgroup's effort and available resources, the targeted organizations were deemed to provide an excellent starting point for exploring mercury use and P2 opportunities. Suggestions will be addressed in the auto subgroup's recommendations, considering the findings of the outreach efforts with the above mentioned organizations.

3.6.2 Sources & Alternatives

Mercury in Auto Manufacturing in Michigan - Through meetings and conference calls with the AAMA members' environmental staff, it was noted that mercury was already receiving attention at Chrysler, Ford, and General Motors through the Auto Pollution Prevention Project (Auto Project) which was initiated in 1991 by the three companies and the MDEQ to focus attention on reducing emissions of persistent toxics into the Great Lakes from automotive manufacturing operations. A complete copy of the latest Auto Project report, which includes the list of 65 persistent toxics, is available through MDEQ-EAD 1-800-662-9278, or by contacting AAMA.

A similar project was initiated in Canada between the auto companies and government officials. The U.S. Auto Project team and the Canadian team meet periodically to review actions, accomplishments and matters of coordination.

Mercury has been on the list of persistent toxics and several examples where companies have reduced or eliminated mercury were discussed (See Auto Project report cited above for a case example of Chrysler's effort that reduced mercury use when the company moved its corporate operations from Highland Park to Auburn Hills). It was also noted that an important element of the Auto Project action plan is an effort to encourage suppliers to support the project in two ways: **a)** through their efforts to reduce potential persistent toxics emissions from materials they may provide to Chrysler, Ford and/or General Motors; and **b)** through P2 efforts within their own manufacturing operations.

In connection with the auto subgroup's outreach efforts, company and MDEQ representatives to the Auto Project provided added attention to mercury at the North American Auto Supplier Environmental Workshop held in Toronto, Canada, on October 20, 1995, sponsored by AAMA and the Canadian Motor Vehicle Manufacturers Association and at the Waste Reduction and Energy Efficiency Workshop, Livonia, Michigan on December 14, 1995 cofunded by AAMA and MDEQ. M2P2 members advised participants of the concerns about mercury emissions into the environment, the voluntary efforts being made by Chrysler, Ford, and General Motors and provided a list of actions that suppliers can address in their use and manufacturing of products so as to reduce potential environmental impacts from mercury.

In the course of discussions with AAMA companies, the auto subgroup used the questions cited in the M2P2 Task Force Chairman's letter to them and information from the Michigan Critical Materials Report. Mercury use at company facilities, while limited, is associated primarily with test-related instrumentation, thermostats and fluorescent lights. The only noted emission source would be combustion from coal-fired boilers.

One Ford plastics plant (Saline, MI) had previously used mercury in its operation; but in 1995 that facility "...discontinued using color concentrates containing mercury compounds to manufacture certain products." This was a direct result of Ford's internal procedure to identify and address materials of concern (For further information, see **Appendix K** for Ford's August 22, 1995 response to the M2P2 Chairman).

It was noted early in discussions by company representatives that there were significant errors in the computer printouts by the MDEQ-SWQD, as reported by the Annual Wastewater Reporting requirement, on the amount of mercury used at AAMA member facilities. AAMA members reported an ongoing awareness of mercury and that P2 efforts will continue to reduce mercury where and when feasible on the already low usage of mercury in instrumentation and thermostats. Use of fluorescent lights makes sense for both energy conservation and lower net mercury emissions, but the M2P2 Task Force could facilitate a more reasonable, cost-effective means for their safe

disposal/recycling which is currently constrained by USEPA's pending fluorescent light/UWR requirements.

A number of assembly plants in Michigan have boilers with coal-fired capability. While detailed discussions were not pursued during these outreach efforts, it is recognized that the Auto Project referred to earlier is placing attention on persistent toxics that might be emitted to the Great Lakes. Generally, mercury emissions from coal-fired boilers from auto assembly operations have been reduced over the past few years due to conversion to less polluting fuels such as natural gas, use of lower sulfur coal, and energy efficiency improvements. For example, as a result of fuel conversions Ford does not currently burn coal at six of their seven boiler facilities. Company efforts under the Auto Project as well as USEPA's current assessment of mercury emissions from commercial boilers should ensure that progress will continue to be made in lowering mercury emissions from these operations.

In a separate discussion with a Mazda plant representative, it was reported that there was little mercury use (i.e., estimated at no more than 10-15 pounds) at the Flat Rock facility. Uses were of similar nature to the AAMA members, such as instrumentation, fluorescent lights, and thermostats.

Taken on the whole, automotive manufacturing operations generally do not use significant amounts of mercury. The only identified source of mercury emissions is from coal-fired boilers where mercury is released as part of the coal combustion process. Pollution reduction efforts in this area have been progressing.

Mercury in Cars & Trucks

In the course of discussions with the targeted organizations cited in Section 3.61, several automotive product applications were identified where mercury is used. Key organizations which were most helpful in discussing and addressing mercury use and concerns about environmental impacts were AAMA members, USCAR-VRP, and SAE.

Table 6.0 identifies the current and/or past mercury applications identified during the outreach efforts of the M2P2 Task Force. Given the thousands of parts in a typical vehicle, AAMA members are working to identify more fully with Tier I & II suppliers where mercury may exist in automotive components. Mercury use in automotive applications is more fully and accurately reported in the SAE paper developed as a direct result of the auto subgroup's outreach effort (See Section 3.6.3 on the SAE effort).

Not all applications could be confirmed in the available time for the M2P2 Task Force effort nor could all specific models be identified even where mercury use, such as switches, is known. While not all applications are in all vehicle product lines, one particular component that uses mercury offers the most significant opportunity for P2 efforts on the part of individual companies. That component is a switch which uses a liquid pool of mercury to activate an electrical signal. It is typically used in convenience lighting applications for underhood and in the trunk. Mercury switches are reportedly

also being used on some anti-lock brake systems, ride control systems and possibly elsewhere.

From our discussions the auto subgroup learned that the switches used for light activation typically contain somewhat less than one gram of mercury. While that is not much for one switch, the number of switches in vehicles disposed of every year is noteworthy. There are about 13 million switches supplied each year for auto use. This means that over 9 metric tons of mercury is supplied annually for auto switch applications. To address its concern about potential mercury emissions from automotive switches, the Minnesota Pollution Control Agency (MPCA) recently conducted a study focusing on switches in vehicles. As a result, the MPCA estimates that about 86,000 switches are disposed of annually in connection with scrapped vehicles in Minnesota, resulting in an estimated 152-190 pounds of mercury being disposed of every year.⁵⁶ Based on a Michigan comparison, it is estimated that approximately 250,000 vehicles are disposed of each year in Michigan. Based on this estimate and the study conducted by the MPCA, this would result in the disposal of 190-240 pounds per year of mercury in Michigan.⁵⁷

While the current fate of these switches is not well known, at least some releases to air and/or to land may be occurring in connection with the end-of-life processes associated with the dismantling/recycling/disposal of cars and light trucks. Accordingly, the auto subgroup requested the M2P2 Task Force Chairman to write a letter to each of the AAMA members requesting their assistance to further Michigan's efforts on pollution prevention through reduced use and/or elimination of mercury switches in their products. Such letters were sent on July 10, 1995 to Chrysler, Ford and General Motors. Each letter also recognized the number of vehicles on the roads now with switches may continue to result in potential environmental impacts for the next decade unless efforts focus attention on the safe disposal/recycling of the switches at the end of the vehicle life. The companies were asked for assistance in providing a focus on switch removal, disposal and/or recycling that could lessen the potential environmental impact.

3.6.3 Current Efforts

AAMA Members - Chrysler, Ford , General Motors

In response to the M2P2 Chairman's July 10, 1995 letter to each of the above companies regarding these switches, each of the three companies have made a commitment to phase out mercury switches, where feasible, starting as early as the 1997 and 1998 model years. The responses from Chrysler, Ford, and General Motors also indicate that a procedure for switch removal from the in-use fleet of vehicles will be developed through AAMA. It is expected that those procedures will need to address the question of identification of switches and that the procedures will be distributed to the vehicle disposal/recycling infrastructure (For more discussion on distribution of these procedures, refer to the USCAR section below.) Specifics for each company are contained in their respective letters to the M2P2 Chairman (**Appendix K**).

While commitment were made independently of each other, these three commitments collectively represent a substantial, voluntary P2 effort since these switches account for the vast majority of any added mercury to the automobile. According to the SAE white

paper, mercury switches used in lighting, antilock brake systems (ABS), and active ride control account for 99.9% of the mercury used in automobiles. The lamp switches account for 87%, the ABS 12%, and the active ride control accounts for 1% of the automotive mercury usage (see more detailed discussion below).

AIAM Members

Feedback to the M2P2 Task Force auto subgroup from the AIAM companies was initially sketchy even though the auto subgroup made a number of attempts to obtain more definitive information from AIAM about their members' products. There are probably various reasons for this, including the delays and difficulties in seeking information from manufacturers based in countries outside the U.S. Nevertheless, what the auto subgroup has learned in discussions with AIAM follows:

- there were several mercury use applications identified for Japanese manufacturers - speedometer systems (<0.04gm, batteries for radios, air bags, anti-lock brakes (ABS), and switches.) Some of the Japanese manufacturers report that they have either phased out or are trying to phase out any significant mercury use.
- for the European based manufacturers, no mercury applications were identified by the auto subgroup except for high intensity discharge (HID) headlamps on BMW models.
- Mazda (the only auto manufacturer in Michigan other than GM, Ford and Chrysler) has no significant mercury use in manufacturing of the vehicle and does not use mercury switches in the models produced at Flat Rock, Michigan. Use of mercury in Mazda models manufactured overseas was not known by the Mazda representative.

These sketchy results suggested the need for more definitive information and potential commitments for P2 efforts from AIAM companies, especially in regard to possible use of switches. To this end, the M2P2 Task Force Chairman wrote a second letter to AIAM specifically raising questions about use of switches and voluntary P2 opportunities. In its response to the M2P2 Task Force Chairman, AIAM reported that it had finally been successful in obtaining a fairly comprehensive picture of mercury use in their member company vehicles (**Appendix L**). Importantly, AIAM companies listed in their letter have indicated their phase out of mercury use which was keyed to the Swedish ban on mercury, effective in January of 1993. The only reported use not phased out or being phased out is on HID headlamps for one manufacturer where the amount of mercury in one headlamp is 0.5 mg. It should be noted that Audi was not listed in the AIAM letter and Honda was indicated as not having used mercury. The study by the MPCA⁵⁸ had indicated mercury switches removed from Audi and Honda models.

The data in the AIAM letter also indicates that even though mercury switches are phased out of new vehicles, they will remain in use on the existing fleet vehicles on the road for a number of years. Therefore, the switch removal procedure being developed through AAMA should be distributed to AIAM and in turn to its members for

concurrence/modification of applicability to their vehicles. Results should be provided to the vehicle disposal/recycling infrastructure.

SAE - The letter to the SAE chairman for the Design and Manufacturing for the Environment Committee has also been productive. The SAE committee chairman agreed on the need to focus attention on mercury in the standardization process as a way to raise the consciousness on the issue in the design of vehicle components and systems. The committee developed a technical paper which provided this focus. The paper was presented at the SAE annual conference in Detroit on February, 27, 1996, titled, "Mercury in Automotive Systems - A White Paper" by Jim Nachtman and Doris Hill, General Motors. The paper will be distributed to key SAE committees and members of the society. The paper focuses on current mercury use in vehicles and provides recommendations to encourage elimination/reduction of mercury in future vehicle components. The M2P2 Task Force Chairman presented Michigan's concerns and voluntary P2 efforts underway at the conference. A M2P2 Task Force member also presented their views on life cycle aspects of the automobile.

The combination of efforts being advanced through the SAE should add an important ingredient to the commitments by Chrysler, Ford and General Motors - namely, direction to the automotive supplier community on the concern about mercury and the need to seek elimination/reduction in future auto products. The SAE effort should result in benefits not only to Michigan but the nation. The auto subgroup of the M2P2 Task Force facilitated two letters of support (one from the Chairman of the M2P2 Task Force and one from Governor John Engler) to the president of SAE for the development of the SAE paper. The president of SAE had responded by giving his support and personal attention to the issue (See **Appendix M** for a copy of these letters).

USCAR - Discussions with representatives of USCAR's Vehicle Recycling Partnership revealed that the VRP had already identified mercury as a substance for attention and elimination/reduction in the design of the vehicle so as to facilitate environmental improvement in the recycling of the vehicle. It was noted that the vehicle is the most recycled product on the market. Currently, 94% of automobiles which go out of registration are recovered for recycling and 75% of each vehicle by weight is recycled. However, while the VRP has begun to investigate mercury switches during vehicle disposal/dismantling, these switches are not generally recycled [i.e., except for a recent mandated removal and return requirement in Minnesota] The fate of these mercury switches and their liquid mercury contents has, therefore, not been studied to any significant degree by the VRP.

The VRP is generally focusing on ways to facilitate further efforts in recycling, including criteria for more environmentally friendly design considerations. The USCAR-VRP has also established a network of interaction with the disposal/recycling infrastructure of the business. This will likely prove helpful to furthering P2 efforts in the future, especially when the AAMA develops a procedure for switch removal. The procedure can be communicated to the VRP and through the VRP to the disposal/dismantling infrastructure of the business. The M2P2 Task Force Chairman has

written a follow-up letter to USCAR citing the manufacturers' commitment about switches and development of a removal guideline. The letter also requests USCAR's cooperation in disseminating the guideline when it is available from AAMA.

MPCA - MPCA has been assessing and encouraging P2 opportunities in Minnesota for vehicle recycling, including required removal of mercury switches. The M2P2 Task Force auto subgroup members joined MPCA in a meeting with USCAR to learn of the Vehicle Recycling Development Center & to foster P2 efforts. MPCA reviewed their study of auto shredder residue on 600 vehicles, with special attention on mercury switches.⁵⁹ The auto subgroup also facilitated discussions between the SAE and the MPCA. Those discussions were helpful in the development of the SAE paper on mercury.

3.6.4 Auto Subgroup Conclusions

The M2P2 Task Force auto subgroup has conducted a thorough survey of potential sources of mercury release to the environment from the automobile industry. The auto subgroup examined the potential for release of mercury from both facilities and products. The auto subgroup work has been facilitated by the cooperation of many in the auto industry, including representatives from the three major U.S. manufacturers. The auto subgroup also enlisted the aid of representatives from AIAM, SAE, USCAR, and MPCA. The key conclusions for the auto sector regarding mercury use, awareness and P2 efforts follow:

MANUFACTURING:

- automobile manufacturers are not a major source of mercury emissions from manufacturing operations;
- the Auto Pollution Prevention Project will continue to focus P2 efforts on persistent toxics, including mercury, in Chrysler, Ford, and General Motors manufacturing operations and through outreach efforts in supplier operations;
- automobile manufacturers have been reducing mercury emissions from boilers by conversion to less polluting fuels, by energy efficiency improvements and/or by use of lower sulfur coal;

PRODUCT:

- several uses of mercury in product applications indicated P2 opportunities, especially in regard to switches,
- the ultimate fate of mercury switches and their mercury contents at disposal/dismantling is not well known;
- P2 outreach efforts are having an effect in raising product-side attention on mercury and P2 efforts;
- nearly all of the more significant uses of mercury on AIAM member company vehicles have been or are being phased out;
- The collective, voluntary P2 commitments by Chrysler, Ford, and General Motors to

eliminate mercury switches in future vehicles where feasible and to develop a safe removal/disposal procedure for use by dismantlers represent a significant effort to reduce potential adverse impacts to the environment;

- the SAE paper will be helpful on P2 efforts with regard to eliminating/reducing mercury use in future automotive products;

3.6.5 Automobile Subgroup Recommendations:

1) The American Automobile Manufacturers Association should develop a mercury-containing switch removal procedure for current vehicles by dismantlers to foster safe handling and disposal.



2) MDEQ should follow up on the letter from the Association of International Automobile Manufacturers (AIAM) requesting assistance in addressing disposal/recycling needs regarding mercury switches in the current fleet of their member company vehicles.

3) The American Automobile Manufacturers Association or MDEQ should provide the switch removal procedure to AIAM for a determination of applicability to the vehicles noted in recommendation 2 above.

4) MDEQ should provide adequate resources for quality assurance checks on the Michigan Critical Materials Report and computer processing if the report is to provide a reliable basis for monitoring use and potential releases of mercury in the future.



4.0 MERCURY EMISSIONS FROM UTILITIES

4.1 Introduction and Current Regulations

Mercury is a naturally occurring element, and as such it is normally found in coal and oil and is released into the atmosphere when the fuel is burned. Combustion sources account for the majority of atmospheric anthropogenic mercury released to the environment both within the state of Michigan and nationally. Electric utilities that burn coal and oil for fuel and municipal waste incinerators that burn their wastes for disposal comprise the top source categories, both state-wide and nationally. The April 10, 1995 draft USEPA utility study determined that utilities are

currently responsible for approximately 18% of atmospheric mercury deposition nationwide and 20-40% in the southeastern Great Lakes region. USEPA is refining this estimate, which may change in the final report.

1990 Clean Air Act (CAA) Provisions

“municipal waste combuster rules have been finalized and medical waste incinerator rules will be proposed in 1996 that should reduce mercury emissions.”

Most source categories including municipal and medical waste incinerators will be regulated by new federal regulations. Municipal waste combuster rules have been finalized and medical waste incinerator rules will be proposed in 1996 that should reduce mercury emissions. No such regulations have been proposed for utilities. Section 112(n)(1)(A) of the 1990 CAA requires a report be submitted to Congress, known as “The Utility Study.” This study requires USEPA to “study the hazards to public health reasonably anticipated to occur as a result of emissions by electric utility steam generating units of pollutants” listed in the CAA [that includes mercury] “after imposition of the requirements of the CAA”. USEPA was required to report the results of this study to Congress by November 1993, however the report is not expected to be submitted until 1996. USEPA is required to develop and describe “alternative control strategies for emissions which may warrant regulation.” USEPA shall regulate electric utility steam generating units, if they find such regulation is “appropriate and necessary” after considering the results of the study.

The Natural Resources Defense Council (NRDC) sued USEPA over the missed deadline, and in a 1994 settlement agreement established a new deadline of November 15, 1995 and USEPA was also granted a 60 day extension, therefore the new deadline was January 15, 1996. USEPA missed this deadline. The report is expected to be released sometime in 1996. The settlement also included additional deadlines by which USEPA must propose and promulgate mercury utility control rules in the event USEPA decides that controls are “appropriate and necessary.” November of 1998 is the deadline by which USEPA must propose any possible regulations, and November of 2000 is the deadline by which USEPA must promulgate any possible regulations.

The USEPA utility study will analyze both the cumulative impact of all power plants as well as the impact of individual power plants. Additionally, this report will not only consider air inhalation standards, but will also look at the broader issue of mercury deposition in rainfall and eventual bioaccumulation in fish.

At this time it is uncertain as to both the content and timing of the report’s conclusions. In the event USEPA finds that mercury power plant controls are “appropriate and

necessary,” those regulations will become enforceable at the state level as USEPA delegates their control program to Michigan.

The mercury study required under Section 112(n)(1)(B) of the 1990 amended CAA requires USEPA to submit a study to Congress by November 1994 on “mercury emissions from electric utility steam generating units, municipal waste combustion units, and other sources, including area sources.” The study “shall consider the rate and mass of such emissions, the health and environmental effects of such emissions, technologies which are available to control such emissions and the costs of such technologies.” This study was to be submitted to Congress by December 15, 1995, however this deadline was also missed by USEPA and is expected to be submitted sometime in 1996.

The Electric Utility Industry

Nationally, the electric industry is in transition. Due to advances in technology, market pressures, and customer options, the electricity industry is moving away from the traditional vertically integrated monopoly utility provider towards an industry structure that reflects some deregulation and competition, particularly within the generating sector. Some elements of the traditional monopoly would remain in the transmission and distribution sectors of the industry. With the advent of competition, some state-mandated environmental regulation and energy efficiency programs may be considered anti-competitive, because they would have the effect of increasing the electricity rates of the state’s electricity providers. Large industrial and commercial customers in a state whose utilities are subject to higher environmental compliance costs may simply choose to purchase less expensive electricity from neighboring states, or even move their businesses to those states.

Michigan’s Environmental Regulations of Utilities and Air Toxics

Mercury is considered an air toxic and as such is addressed by both state and federal programs. The existing Michigan air pollution control rules apply to emissions of toxic air contaminants from individual new or modified sources and they evaluate their effect on ambient air quality, in particular human health air inhalation standards. These rules utilize screening models to determine whether a particular source has any potential to exceed air inhalation standards. Mercury emissions from individual power plants do not exceed the screening model trigger values. However, MDEQ-AQD staff recognize that this approach does not include exposure of mercury from other routes of exposure, such as fish consumption. Therefore, there is a provision in the regulations that allows the MDEQ-AQD to determine on a case-by-case basis, that the maximum allowable emission rate may not provide adequate protection of human health or the environment. In this case, the MDEQ-AQD can establish a maximum allowable emission rate considering all relevant scientific information, such as routes of exposure other than direct inhalation, synergistic or additive effects from other toxic air contaminants, and effects on the environment. [Pursuant to MDEQ-AQD’s air toxics rules 230-232, promulgated pursuant to Article II, Chapter 1, Part 55 (Air Pollution Control) of P.A. 451 of 1994 (NREPA)].

Michigan Public Service Commission

The Michigan Public Service Commission contributes to the energy policy of the state through its regulation of investor-owned electric and gas utilities and cooperative electric utilities. Currently, there is a state-wide process underway to recodify the energy and utility regulatory statutes in Michigan in order to streamline and modernize them. The modernization effort is an attempt to restructure the energy utility industry towards competition, similar to what is occurring nationally.

4.2 Sources & Alternatives

(See **Appendix O** for a summary of the contribution of fossil fuel, nuclear power and renewable energy for Michigan's present energy needs.)

4.2.a. Sulfur and Mercury Content in Coal

Higher mercury concentrations in coal tend to be associated with higher sulfur contents, although there are notable exceptions to this rule. Chapter 5 of the April 10, 1995 draft Electric Utility Hazardous Air Pollutant Report to Congress discusses the relationship between mercury content and sulfur content, the differences in these values between different coal mining regions in the country, and the effect of coal washing.

Unwashed Eastern coals tend to have higher mercury concentrations than either washed Eastern coals or Western coals. Not all Eastern coals are washed because some have naturally low sulfur concentrations. No Western coals are washed because they are all low in sulfur. Washing removes the heavier pyritic particles. Pyrite is a chemical combination of iron and sulfur. Mercury, where it appears in high concentrations in coal, is often in the pyrite minerals. Most of the coal utilized in the country today is low sulfur coal. In the past, most of the coal was much higher in sulfur content.



Table 5-2 of the April 10th version of the Draft USEPA Utility Study states that the national average mercury concentration in coal is 7.69 pounds mercury/trillion BTUs. In 1994, Detroit Edison and Consumers Power reported coal mercury concentrations which are below the national average, based on their estimate of 5 pounds mercury/trillion BTUs. The two utilities estimated they emitted a combined total of 2,000 pounds of mercury in 1994, based on actual coal samples. Since these two utilities represent 86% of Michigan utilities' coal usage, this estimate translates into a statewide utility emission rate of about 2,200 pounds. MDEQ-AQD estimates that all Michigan utilities emitted 4,240 pounds of mercury annually in 1994 and USEPA estimated that all Michigan utilities emitted 3,560 pounds of mercury in 1991.

4.2.b. Natural Gas and Nuclear Energy

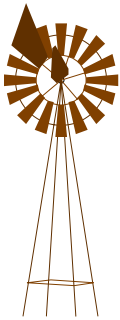
Using natural gas as an energy source greatly reduces mercury emissions. New power plants fueled by natural gas achieve greater thermal efficiencies than coal fired power plants, making natural gas the most economically feasible non-renewable fuel for power

plants. Economics dictate that most of the non-renewable new power plant construction in Michigan for the foreseeable future will be natural-gas-fired combined cycle units.

However, converting existing coal fired power plants to natural gas results in a loss of thermal efficiency due to boiler design, which make natural gas firing more expensive than coal firing in existing units. Replacing existing single cycle boilers with combined cycle boilers for natural gas would result in increased thermal efficiency, but requires significant capital outlay. Additionally, concerns over natural gas supply availability and price volatility raise questions regarding an over-reliance on natural gas for primary and secondary electricity generation.

Nuclear energy is an alternative energy source to fossil fuels that is a non-emitting mercury source. Although no mercury is released from this source, this energy source is surrounded in current debates related to issues on waste disposal and storage, construction and licensing costs and determining facility locations. Michigan's reliance on nuclear energy is currently about 19%.

4.2.c. Renewable Energy Sources



The term “renewable energy resources” essentially refers to any of a diverse group of energy resources whose common characteristic is that they are non-depletable or naturally-replenishable. Wind energy systems produce electricity by using the wind to transmit the rotational energy of a rotor (windmill) to a generator or alternator. Solar energy systems refer to the conversion of the Sun's light or radiation to electricity or heat, depending on the desired application. Solar photovoltaics (PV) are solar energy systems that convert the sun's light directly to electricity through a photochemical process. Solar thermal systems are solar systems that convert the Sun's radiant energy to heat, which can be used for direct heating purposes, such as space heating or water heating, or can be used to power electricity generators for electricity supply. Biomass energy refers primarily to the burning of plant material, usually culled from forest and agricultural activities, for the purposes of powering an electricity generator.

Many renewable energy sources create no mercury emissions, others emit less than from burning coal. Both wind and solar power produce clean renewable energy for which some Michigan citizens have demonstrated a willingness to pay a higher rate. Landfill gas and biomass are also considered renewable energy sources, however mercury emissions can also be released from these forms of energy. As the demand for these renewable energy sources increases, the cost is expected to decrease in the future. However, for the moment, most renewable energy sources are expected to cost more than fossil fuel alternatives.

It is also currently technically feasible to transform renewable solar energy into electrical energy with a PV system. However, full utilization of solar power is inhibited by the cost

of PV cells. Efforts are currently underway to produce lower cost PV cells thus making solar power more economically feasible, although experts disagree whether solar conditions in Michigan are favorable to the development of solar power.

Another renewable energy source that is also available is landfill gas. The landfill is capped to allow capture of methane gas discharges, which are then used as an energy source for power plants. Within the next few years, gas from currently capped landfills is expected to create between 100 and 200 MW of energy in Michigan, about 1% of the state's energy demands. While landfill gas can also contain mercury it is believed to be significantly less than mercury emissions from burning coal. Additionally, as mercury use continues to decline in consumer products, mercury landfill emissions should also decrease.

Based on the draft USEPA mercury study, the average mercury concentration in wood is one pound mercury/trillion BTUs. The efficiency of a wood-fired boiler is less than that of a fossil fuel-fired boiler. Therefore, more wood (on a BTU basis) is needed to produce the same amount of electricity.

4.2.d. Energy Conservation and Energy Efficiency

“Energy conservation and efficiency programs reduce the demand for energy.... The decreased energy demand from DSM programs can also decrease mercury emissions, especially if the savings are allocated to coal fired power plants.”

Energy conservation and efficiency programs reduce the demand for energy. By order of the Michigan Public Service Commission, Detroit Edison and Consumers Power have implemented energy conservation (DSM) programs for residential, commercial and industrial customers. The programs assist customers with installation of more efficient machinery, lighting, heating and cooling systems. The decreased energy demand from DSM programs can also decrease mercury emissions, especially if the savings are allocated to coal fired power plants. Some experts argue, however, that the reduction in the amount of coal burned resulting from energy conservation programs is small and has little effect on mercury emissions, while others argue that significant reductions in carbon dioxide and sulfur dioxide make this option environmentally and economically attractive.

4.3 Current Efforts

4.3.a. Renewable Energy Projects

Traverse City Power & Light recently constructed a windmill which will provide electricity to 200 residents. The residents voluntarily chose to pay a higher “green” rate for the clean energy, which does not produce any pollutants. Further exploration is necessary to determine sites in Michigan which are feasible for wind energy production.

The Department of Energy (DOE) has recently agreed to subsidize the cost of constructing a small solar power plant in Michigan. Detroit Edison applied jointly with eight other states to test the marketability of PV generated electricity for residential and commercial customers. Test markets have shown that there is a market for PV generated electricity if the costs decrease. This system is expected to be installed spring of 1996

and operating by May 1996. Detroit Edison working in cooperation with DOE will test market the public's willingness to pay higher rates for "green power" and to advance the industry's knowledge and ability to manufacture lower cost PV cells.

Independent power producers, most notably affiliates of Consumer Power, have been responsible for much of the recent wood-to-energy power plants in Michigan and can be expected to continue to review the opportunities to utilize this fuel. Although wood-fueled power plants have played an increasingly important part in new plant construction, wood, like other forms of biomass, including coal, contains mercury.

4.3.b. Coal Switching

USEPA states that "switching to Western and select Eastern coals containing less than 15 pounds mercury per trillion BTUs could reduce mercury emissions from utility units" as cited in the draft Utility Study. During the last 20 years, Michigan utilities have switched from high sulfur Eastern coals to low sulfur Eastern and Western coal. **Appendix P** compares twenty years of Detroit Edison's analyses of sulfur and mercury in its coal supply. Over this twenty-year time period, there has been a three-fold reduction in the concentration of mercury in the coal utilized by all Michigan utilities (the state average is estimated at 5 pounds mercury per trillion BTU). It is not known at this time if any additional coal switching would facilitate mercury emission reductions.

4.3.c. Energy Conservation Programs

Although the Michigan Public Service Commission (MPSC) had previously ordered Detroit Edison and Consumers Power to design and implement energy conservation programs for their electric customers, both utilities recently argued that the impending threat of open competition in the electric industry warranted elimination of DSM programs. The MPSC decided to allow Consumers Power and Detroit Edison to end certain components of their DSM programs. In its decision in the Consumers Power case, the MPSC encouraged the utility to "rethink the existing paradigm and unbundle DSM so that the service can be provided to customers who desire it just as other products and services in competitive markets." The future of utility DSM programs is thus uncertain at this time.



4.4 Recommendations for Future Efforts

It has been well established that mercury emissions from utilities are significant and at this time are uncontrolled for mercury. Because the emissions and subsequent deposition of mercury impact not only Michigan, but bordering states as well as Canada, and because of industry deregulation, a national and binational approach is recommended. The M2P2 Task Force does not want to place Michigan utilities at a disadvantage over neighboring states.

The M2P2 Task Force discussed, at length, the feasibility of incorporating environmental costs and impacts ("internalizing externalities"), relative to mercury emissions and

subsequent deposition, as part of the utilities' future resource planning and fuel choice. While a consensus did form around the need for further study of environmental costs and impacts, none was achieved as to their role in resource planning, fuel choices or the regulatory process before the MPSC.

The M2P2 Task Force believes there are several options that exist for Michigan utilities to be proactive in taking a role to help reduce the over 2,000 pounds of mercury released from Michigan utilities.

1. The M2P2 Task Force, the MDEQ and the MPSC should encourage USEPA to finalize the mercury and utility studies and ensure that significant resources are allocated to determine the scientific basis to promulgate national standards for mercury emissions from electric utility boilers.

2. The MPSC and the MDEQ, working in cooperation with Michigan utilities, should support additional research efforts to evaluate the full environmental costs and impacts of mercury emissions and subsequent deposition from electric power generation.

A study should be conducted that includes an evaluation of the costs and benefits of various reductions in the emissions of mercury from existing coal-fired power plants. The study should evaluate the full costs of mercury contamination to Michigan's and the Great Lakes region's economies, including impact on the health of people, wildlife, fisheries and the recreation and tourism industries. The study should evaluate the environmental and economic benefits that might be expected to accrue to Michigan and the Great Lakes region, including reduced health risks to people consuming fish, as a result of reduction in mercury emissions from electric power generation. This study should be coordinated with the ongoing Agency for Toxic Substances and Disease Registry (ATSDR)-funded research in Michigan on mercury levels in women of childbearing age. The study should also include such other areas of inquiry as deemed appropriate by a committee composed of representatives of the Governor's Relative Risk Air Quality Issues Task Force, the Office of Regulatory Review, the MPSC, the MDEQ and interested stakeholders including representatives of the public, environmental organizations and power companies.

"Michigan utilities should continue to support projects on evaluating renewable energy sources, including wind and solar energy."

3. Michigan utilities should continue to support projects on evaluating renewable energy sources, including wind and solar energy. The results of all applicable studies should be shared with the MPSC and the MDEQ and if determined to be economically and technically feasible additional reliance on renewables should be implemented.

4. The M2P2 Task Force calls upon electric utilities to factor in the costs and benefits of mercury emissions control into all Environmental Impact Statements (EIS) required under federal and state law.

5. The M2P2 Task Force calls upon Michigan utilities to develop a plan with timetables and goals that are measurable, in quantitative or other terms, as well as means to achieve the goals, to further reduce mercury usage or emissions from the generation of electricity and/or other sources. This plan should be submitted to the MDEQ and the MPSC and progress in achieving mercury reductions should be reported on an annual basis.

Utilities have the flexibility to reduce mercury usage and emissions through any of a number of options. Individual utilities or utilities acting in concert will report annually to MDEQ and the MPSC on activities which result in the reduction of mercury usage and/or emissions at the state, regional, national, or global scales. These types of activities may include, but are not limited to:

- Investigating opportunities for fuel switching
- Investigating opportunities for increasing the use of washed coal or coal with a lower mercury content.
- Increasing the use of renewable energy sources
- Purchasing policies aimed at low to zero mercury content products
- Participation in the USEPA's National Mercury Task Force process
- Participation in a comprehensive education/outreach campaign on mercury reduction, with an emphasis on energy conservation
- Advocating and/or participating in utility industry research activities related to mercury impacts on the ecosystem, improvement of emissions inventory techniques, or emission reduction technology
- Advocating and/or participating in energy conservation programs aimed at developing economies, world-wide, which benefit reductions in a variety of pollutants, including mercury
- Demand side management
- Participation in USEPA's Green Lights Program
- Evaluate available control technologies

Selection and implementation of any voluntary measures would be based on utility's flexibility in determining the most cost-effective mix of prevention initiatives that result in a reduction of mercury usage and emissions.



“...the state of Michigan should set an example by implementing programs that focus on the pollution prevention of mercury.”

5.0 RECOMMENDATIONS FOR MICHIGAN STATE GOVERNMENT

The M2P2 Task Force recognized that in order for their recommendations to be implemented successfully, the state of Michigan should set an example by implementing programs that focus on the pollution prevention of mercury. If Michigan's government can be proactive by implementing many of these initiatives, privately owned facilities may be more apt to follow suit.

5.1 Current Regulatory Efforts

Battery Legislation

Public Act 124, was signed into law on June 29, 1995. This act bans the sale of alkaline batteries containing mercury (with the exception of alkaline manganese button cells containing less than 25 mg of mercury), and zinc carbon batteries containing mercury beginning January 1, 1996. The sale of mercuric oxide batteries (with the exception of button cells) is also banned after January 1, 1996, unless the manufacturer identifies a collection sites for recycling, informs users of the locations and informs the purchasers of a telephone number that the purchaser may call to get information about returning mercuric oxide batteries for recycling or proper disposal.

Air Regulations

MDEQ-AQD's air toxics rules 230-232, promulgated pursuant to Article II, Chapter 1, Part 55 (Air Pollution Control) of P.A. 451 of 1994 [the Natural Resource and Environmental Protection Act (NREPA)], limits the amount of mercury emitted from a source based on a predicted maximum ambient impact that must not exceed 0.3 ug/m^3 over a 24 hour average (inhalation only). However, the AQD can determine on a case-by-case basis, that the maximum allowable emission rate may not provide adequate protection of human health or the environment. In this case, the AQD can establish a maximum allowable emission rate considering all relevant scientific information, such as exposure from routes of exposure other than direct inhalation, synergistic or additive effects from other toxic air contaminants, and effects on the environment.

Clean Air Act

In addition to the Utility Study and Mercury Study provisions required in the amended 1990 Clean Air Act (CAA) described above in Section 4.1, sources will also be regulated by source category for mercury emissions through technology based control standards. USEPA has finalized performance standards for municipal waste combustors and will finalize performance standards for medical waste incinerators by 1996. USEPA will finalize performance standards by 2003 for hazardous waste incinerators and cement kilns which burn hazardous waste. The following additional source categories are expected to be regulated for mercury emissions: chlorine producing facilities (none are

located in Michigan), commercial/industrial boilers, primary lead and copper smelters (the only copper smelter in Michigan is currently shut down), portland cement kilns, sewage sludge incinerators and lime manufacturers.

The 1990 CAA Section 112(m) also requires USEPA to determine the contribution hazardous air pollutant (including mercury) deposition makes to water pollution in the “great waters” that includes the Great Lakes, Lake Champlain, Chesapeake Bay and coastal waters. This study is known as the “Great Waters Study;” USEPA submitted their first Great Waters report to Congress in May of 1994 on the progress of this study and USEPA is required to submit follow-up reports every two years.

Section 112(c)(6) requires EPA to compile an inventory of all sources that emit specific pollutants of concern to aquatic systems, including mercury by November 1995. EPA must assure that “sources accounting for not less than 90% of the aggregate emissions of each pollutant” are subject to emission standards. These standards shall be promulgated no later than the year 2000. Electric utilities are exempt from this regulation.

Water Regulations

MDEQ-SWQD currently requires companies to report under NREPA, P.A. 451 of 1994, Part 31, Section 324.3111 of the Michigan Compiled Laws, Annotated (formerly Act 293). This section outlines the Critical Materials Register and Wastewater Report, also known as the Annual Wastewater Report, or AWR. Every business with a nonsanitary wastewater discharge (i.e., process or cooling water; any discharge other than human sewage) to the waters of the state (surface water, groundwater, surface of ground, lagoon or septic systems), or any publicly owned treatment works (POTW), must report. Facilities with sanitary discharges (i.e. human sewage) to destinations other than septic systems or POTWs must also report. Stormwater discharges are exempted. Facilities are required to report, annually, the nature of their business; the nature of their discharges; and all Critical Materials present on-site [Critical Materials are materials listed on the Michigan Critical Materials Register (CMR) as materials of concern to human and environmental health, and includes 315 metals and specific organic chemicals and several other groups of compounds considered toxic in all its forms. Therefore, elemental mercury and all mercury compounds are grouped together as CLASS021.] Required CMR data includes total amounts present on-site, the quantity discharged in wastewater, and disposed of as waste materials, cumulatively over the course of the year. No threshold level for reporting is granted for any Critical Material which is discharged in wastewater or disposed of as a waste material in any quantity. A threshold level of one pound, present on-site cumulatively over the course of the year is granted, for all Critical Materials which are not discharged in wastewater nor disposed of as waste materials in any quantity.

SWQD also requires mercury minimization plans (MMPs) in the Clean Water Act (CWA) National Pollutant Discharge Elimination System (NPDES) permits of municipal wastewater treatment plants (WWTPs) when mercury is detected in the influent, effluent or sludge at levels of concern. SWQD is currently proposing that POTWs be allowed to establish similar requirements in the permits of those industrial users (dischargers into

sanitary sewers) that have been identified as sources of mercury. At the core of this proposal is the development of a mercury reduction plan (MRP) by industrial users. These MRPs would describe how the industrial user intends to identify, reduce, and ultimately eliminate its mercury discharge to the POTW. In order for a POTW to require and enforce the MRPs in an industrial permit, they will need to establish the necessary legal authority. Initially, SWQD will send all municipalities with MMPs a packet of information which will assist them in the development of specific ordinance language and implementation procedures necessary to effectively implement the MRP strategy. SWQD is currently implementing a pilot MRP project for the city of Holland.

Waste Regulations

MDEQ-WMD regulates mercury-containing wastes, such as fluorescent lights under Michigan's Hazardous Waste Management Act, 1979 PA 64, as amended, recodified as Part 111 of NREPA, 1994 PA 451, as amended. Currently mercury-containing wastes must be properly characterized for disposal purposes. If wastes exhibit a hazardous waste characteristic under the Toxicity Characteristic Leaching Procedure (TCLP) test then the mercury-containing wastes must be managed accordingly. The Michigan Hazardous Waste Management Act also requires the tracking of hazardous waste through a manifest tracking system and is also administered by WMD.

Additionally, Part 111 also regulates the use of lamp crushing devices such as drum top crushers as treatment. If lamps have been determined to be hazardous, a hazardous waste treatment permit would be required for these devices unless generated by a conditionally exempt small quantity generator (i.e. generates less than 220 pounds per month of hazardous waste.) Lamp crushing does not require hazardous waste permitting if the crushing is part of a recycling process in which the mercury or other lamp components and constituents are collected for the purpose of recycling. However, this process must be reviewed under Michigan's Air Pollution Control Act and may require an air permit, recodified as Part 55 of the Natural Resource and Environmental Protection Act.

At the federal level, the UWR, finalized May of 1995, streamlines the hazardous waste management regulations governing the collection and management of batteries, pesticides and thermostats, see Section 3.4.3.e. MDEQ-WMD has proposed in October 1995 to update its hazardous waste management program administrative rules promulgated pursuant to Part 111 and adopt the UWR. The proposal includes thermostats, batteries, banned pesticides and mercury-containing lamps as universal wastes.

Additional Michigan Non-Regulatory Efforts Michigan Public Service Commission

The MPSC currently requests Detroit Edison and Consumers Power to report semi-annually on their mercury emission estimates. Although the two power producers are complying with this request, the companies do not conduct stack tests. They analyze the content of their coal for mercury and estimate emissions based on throughput information.

RAPIDS

The Regional Air Pollutant Inventory Development System (RAPIDS) administered by the Great Lakes Commission and funded by the regional Great Lakes Protection Fund, USEPA and the states is an eight Great Lakes state air toxics emission inventory. RAPIDS is a necessity in order to help identify sources that emit mercury to the atmosphere. The reference tables from RAPIDS was one of the tools used to develop the Michigan mercury emissions estimate in Appendix B. A pilot study of RAPIDS was tested on twelve counties bordering southwest Lake Michigan, a final report is now available and can be obtained from the Great Lakes Commission, Ann Arbor, Michigan. The final inventory housed at USEPA-Great Lakes National Program Office and accessible by all of the Great Lakes states and the public through the Internet system, will be available in 1997. This multi-million dollar inventory will be key to identify sources of air toxics, help prioritize efforts and initiate and help support efforts to reduce toxic air pollutants.

Legislative Mercury Workshop

Minnesota received a USEPA grant to hold a legislative mercury workshop for the Lake Superior States. Michigan, Wisconsin and Minnesota staff as well as state legislators from all three states participated in this workshop held September 18, 1995 in Minneapolis, Minnesota. An overview of the mercury issues in each state were presented and open discussion followed on mercury reduction legislative possibilities.

Lake Superior Binational Program - Zero Discharge Demonstration Project

MDEQ staff are participants on the Lake Superior Binational Forum and the Lake Superior Pollution Prevention Team (the overall goal is zero discharge and emissions of toxic pollutants into the Lake Superior Basin, mercury is one of nine pollutants of concern.) The Lake Superior Binational Forum set the goal that by the year 2020 there would be virtual elimination of mercury into the Lake Superior Basin. The Lake Superior Pollution Prevention (P2) Team released the Lake Superior P2 Strategy October 1993 and a follow-up implementation plan August 1995. The mercury conclusions and recommendations are included in **Appendix Q**. Various efforts in the Lake Superior Basin are being implemented under the guidance of this zero demonstration project including a Zero Discharge Pilot Project at the Western Lake Superior Sanitary District facility located in Duluth, Minnesota.

Lake Superior Mercury Monitoring funded by Settlement Monies

A settlement with the Copper Range Company located in White Pines, Michigan (currently not operating) with the USEPA and the states of Wisconsin and Michigan

resulted in monies being awarded to conduct environmental projects to pay for damages from air toxic emission exceedances. Projects funded include mercury ambient monitoring for both wet and dry deposition, air-water exchange monitoring, throughfall and litterfall sampling of mercury and source apportionment work to help identify source regions impacting the Lake Superior Basin.

Grant Awarded Efforts

MDEQ-AQD staff sought and obtained a \$35,000 grant from the Saginaw Bay National Watershed Initiative (in the Office of the Great Lakes, MDEQ). Funding will be awarded to the Genesee County Environmental Health Department-Environmental Health Services Division located within the Saginaw Bay Watershed to conduct an education/outreach and collection program for mercury-containing wastes. This project was initiated March of 1995 and will serve as a pilot for other Michigan counties to follow.

The MDEQ pursued and received a grant from USEPA - Region 5 for approximately \$50,000 to conduct an education/outreach effort for facilities that operate medical waste incinerators (MWIs). The first objective is to identify the currently operating MWIs followed by a focused education/awareness program to MWIs with emphasis on identifying mercury P2 alternatives and proper disposal of mercury-containing wastes.

5.2. Recommendations for Future Efforts



“In order for mercury P2 efforts to be successful in MI, a champion is needed to initiate, facilitate, coordinate and implement, if necessary, the numerous recommendations for action.”

5.2.1. Continued State Support

The MDEQ should take the lead in continuing to facilitate the implementation of the numerous recommendations in this report. In order for mercury pollution prevention efforts to be successful in Michigan, a champion is needed to initiate, facilitate, coordinate and implement, if necessary, the numerous recommendations for action. The MDEQ has already demonstrated its willingness to participate by facilitating the design and funding for the first printing of the Merc Concern brochure. The MDEQ should evaluate whether a mercury coordinator position is warranted to direct the numerous needed activities associated with this multi-media pollutant.

Specific Recommendations Include:

- **Facilitate P2 by other state departments regarding mercury** i.e. work with Michigan Department of Education to develop a fact sheet for science teachers and to

develop a mercury education/awareness component in school curriculum in Michigan as well as working in cooperation with MDPH to continue distribution of educational materials for women of childbearing age with regard to eating fish.

- **Define success.** i.e. how do we measure success of mercury reduction efforts?
- **Continue communication with manufacturers and end users of mercury-containing products/devices and identify potential mercury pollution prevention possibilities and encourage implementation.**
- **Develop a “mercury manual” for the MDEQ-EAD Environmental Assistance Center, involving all stakeholders and share with MDEQ district offices.**
(see section 3.1.4.A.)
- **Coordinate the development of additional education/outreach materials.**
- **Work with the various divisions in MDEQ (air, water and waste) to coordinate permitting and, compliance issues related to mercury.**
- **Include mercury P2 information in MDEQ staff training.**
- **Develop a mechanism to recognize mercury-free companies/institutions or companies/institutions that have made a significant mercury reduction effort.**
- **MDEQ should consider a periodic mercury meeting with key stakeholders to maintain focus on voluntary mercury P2 effort and accomplishments.**

5.2.2. The State of Michigan Should Participate in the USEPA Green Lights Program.

The USEPA’s voluntary “Green Lights Program” is one component of its “Energy Star” programs designed by USEPA to overcome obstacles hindering the adoption of energy efficient practices by offering a wide variety of technical and support services. Green Lights began in January 1991, and now has over 1,600 partners including several states. As of January 5, 1995, Michigan had 43 Green Lights partners. Lighting accounts for 20-25 percent of all electricity sold in the United States. Implementing energy efficient lighting saves money, decreases air pollution and increases lighting quality. It is estimated that if Green Lights were fully implemented in the United States over \$16 billion dollars per year would be saved and a 12 % reduction of carbon dioxide, sulfur dioxide and nitrogen oxides would result. Additionally, mercury emissions would also be reduced.



“Implementing energy efficient lighting saves money, decreases air pollution and increases lighting quality.”

Green Lights asks its members to sign a Memorandum of Understanding with USEPA. Participants then agree to survey 100% of their facilities, and within five years upgrade 90% of the square footage that can be upgraded profitably without compromising lighting quality. USEPA offers partners technical assistance with planning and implementation with a variety of tools. A support specialist is assigned to the partner, computer software, fax and phone hot-lines, lighting upgrade manuals, workshops, videos and newsletters are all examples of the many tools and services provided by USEPA. If Michigan signed on as a Green Lights partner money would be saved, this state example would help recruit

local governmental agencies and private companies to participate and the state would help to reduce air pollutants, including mercury. Used fluorescent lights should be handled properly to avoid breakage and release of mercury. If the Universal Waste Rule is adopted in Michigan including fluorescent lights as universal wastes, the revised RCRA regulations would encourage recycling.

“State Government should become a model for other organizations to follow.”

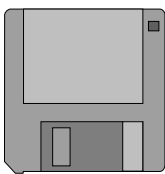
5.2.3. The State of Michigan Department of Management and Budget (DMB) should develop a state purchasing policy that identifies mercury-containing products and purchases mercury-free alternatives, when available.

State Government should become a model for other organizations to follow. In order to accomplish that, employees involved in purchasing, need to become educated as to: 1) what items contain mercury and what are the alternatives to purchasing these items; 2) make educated appraisals of what products are the best value overall for the state; 3) be able to write specifications for products that contain little or no mercury; and 5) write clauses in all statewide contracts that vendors who sell the State products containing mercury must provide a resource to recycle these products once the State is ready to dispose of them. A group made up of knowledgeable people in this field representatives of DMB, MDEQ and MDPH should be set up to facilitate the process. DMB should also enlarge its recycled products program to include products containing mercury. A pilot could be set up to implement this policy, such as the MDNR/MDEQ/MDPH laboratory facilities.

The State DMB already has demonstrated its leadership with energy conservation/efficiency programs by initiating several efforts. This Department has conducted building energy audits, installed digital controls and boiler economizers and coated films on windows. A preliminary survey by DMB, Office of Support Services, revealed that no paints or pesticides containing mercury are used, no mercury-containing thermostats are used and all rechargeable batteries are used.

5.2.4. The State of Michigan should recycle mercury-containing products and wastes, where feasible.

Waste products such as thermostats that contain mercury should be recycled. The state should participate in the reverse distribution recycling program offered by the Honeywell Corporation. Recycling of other mercury-containing waste materials should also be investigated including fluorescent lights and other electrical devices such as mercury switches. Following the pollution prevention hierarchy outlined in the 1990 federal Pollution Prevention Act, recycling follows pollution prevention in the recommended priority list. This recommendation may need to be re-evaluated in the future. The policy on environmental management of mercury may change.



5.2.5. State Mercury Inventory and Databases

MDEQ and MDPH should provide the necessary resources to improve Michigan's mercury inventory data and other data bases of information on mercury. These other data bases should include periodic human and environmental monitoring programs and evaluations of long-term human health exposure studies.

These agencies should dedicate funding resources to institute and maintain a surveillance and monitoring system in order to quantify mercury exposure and measure changes in exposure. Monitoring should include sediments, fish and human tissue. Human monitoring data should be compared with that associated with long-term exposure and mercury effect epidemiological studies of worldwide fish eating populations and if necessary, modify health protection advisories accordingly.

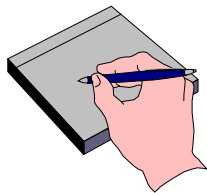
Necessary resources should also be provided to MDPH and the line divisions of MDEQ including SWQD, AQD, EAD and WMD to better quantify mercury sources and evaluate trends within the state. Emphasis should be placed on improving the current tools that are being used/implemented for mercury inventory development.

• RAPIDS

Continue support should be provided to ensure that this invaluable tool is implemented and updated. RAPIDS will provide USEPA and the states and other interested parties the "missing piece of the environmental puzzle" - air toxic emissions - to be used for identifying sources, prioritizing efforts and identifying successful reductions.

• Annual Wastewater Report

The AWR is an invaluable tool for identifying mercury used and discharged to the waters of Michigan. Information used from this report was used by USEPA for their virtual elimination project to help identify mercury use and release in the region. The data will also be useful in implementing the SWQD mercury reduction program efforts. Resources should be provided to inform facilities of the requirements, review and improve the quality of the data and provide reports on increasing or decreasing trends of mercury use and discharge to facilitate evaluation of successful P2 programs.



“Reducing the consumption of coal, reduces the release of mercury to the atmosphere by coal-fired power plants.”

5.2.6. Suggested Mercury Legislation

1. The State of Michigan should create, by statute, a Michigan

Energy Bank with the authority to finance energy audits and energy-related capital improvements for public buildings, including those occupied by state agencies and local school districts. The Energy Bank should provide a variety of financial mechanisms, including bond authority, loan guarantees, and credit support. Energy efficiency projects can reduce the demand for electricity supplied by coal-fired power plants, which may reduce the consumption of coal by these power plants. Reducing the consumption of coal, reduces the release of mercury to the atmosphere by coal-fired power plants. The State of Iowa has undertaken a model energy management program, leveraging energy savings to provide energy-related capital improvements for state agencies [Section 7. Section 93.19 Code of Iowa - Energy Bank Program, as amended in 1991.] In 1985, Iowa created the Facilities Improvement Corporation (FIC) to help state agencies implement energy conservation programs. Such a program can significantly reduce emissions of air pollutants, including sulfur dioxide, carbon monoxide, and mercury, while demonstrating the benefits of energy efficiency in lowering bills and environmental impact for individuals and private sector institutions.

Iowa's program provides engineering analyses to determine measures that would improve the energy efficiency of a building, then leases the improvements to the state agency. FIC can issue bonds to raise the capital needed to start the program -- a significant obstacle to a similar effort in Michigan, which has no such authority. Some 18 facilities have participated in the program, making over \$8 million in energy management improvements. An additional \$11 million in improvements have been made with non-corporation funding. The program projects capital spending under the program of approximately \$40 million over six years for state agencies, with savings from improvements averaging a payback period of six years.

Limited efforts to date in Michigan have shown the potential of such a program. Act 122 of 1987 authorizes state agencies to contract to improve the energy efficiency of a state facility. The agency pays the company over a multi-year period with the savings of reduced energy bills. Any extra savings can be carried over to the next year to finance additional improvements. Reductions in electricity consumption at 12 state facilities (most operated by the Department of Corrections) have prevented the annual emission of over 18 million pounds of carbon dioxide, more than 231,000 pounds of sulfur dioxide, and nearly 78,000 pounds of nitrogen oxides, as well as unspecified mercury reductions.

2. The State of Michigan should enact legislation or revise rules that brings the state's hazardous waste regulations into conformance with the universal waste rule as it pertains to mercury thermostats, batteries and banned pesticides Further, Michigan should seek expansion of the rule to include mercury-containing lamps

and switches, thermometers and mercury-containing medical devices to simplify the collection and recycling of these wastes. [In October 1995 MDEQ-WMD proposed revisions to update its hazardous waste rules and adopt the UWR (Administrative rules to Part 111 of NREPA, 1994 PA 451, as amended.) As of October 1995, MDEQ-WMD has proposed the inclusion of thermostats, batteries, banned pesticides and mercury-containing lamps as universal wastes.]

On May 11, 1995, the USEPA issued a final rule (40 CFR Part 9, 260, 261, 262, 264, 265, 256, 268, 270, and 273) facilitating the convenient recycling of mercury-containing batteries and thermostats as well as other wastes. The rule promotes environmentally sound reclamation by reducing permit requirements for those who collect and transfer the wastes. This in turn reduces the amount of mercury disposed of in landfills and incinerators and resulting mercury pollution. Passage of S.B. 516, enacted as Public Act 124 of 1995, by the Michigan Legislature adopted by reference the new “universal waste rule” for batteries only. Part 111 administrative rules would need to be amended to permit the recycling of mercury-containing thermostats, batteries, banned pesticides, mercury-containing lamps and switches, thermometers and mercury-containing medical devices.

3. The State of Michigan should enact legislation that educates the public on the responsibility of individuals to divert mercury-bearing materials from the waste stream. Similar to legislation enacted in Minnesota, the legislation should prohibit the knowing disposal by any person of mercury-bearing thermometers, toys, games, batteries, fluorescent lights and thermostats in a waste stream directed to an incinerator. Because the legislation is designed to educate individuals and businesses, it should specifically exempt incinerator operators from enforcement for violations committed in the normal course of incinerator operation. (This recommendation should be evaluated following implementation of the CAA, Section 129 standards that requires mercury controls for all municipal waste combustors.)

Despite significant reductions in the contribution of municipal waste combustors to mercury emissions, careless or unknowing disposal of items containing mercury in waste streams directed to incinerators can still have a significant cumulative impact. Individuals can play a part in preventing the release of mercury into the air, and its subsequent deposition in the terrestrial or aquatic environment, by diverting certain mercury-bearing materials from such waste streams.

Enactment of a ban will have several benefits. First, it will directly reduce the amount of mercury released during combustion, reducing emissions as well as reducing the mercury when captured by the air pollution control equipment. Second, it will alert individuals to their role in reducing mercury emissions. Third, it will help prompt individuals to alter their buying habits to avoid the purchase of mercury-bearing materials, a pollution prevention accomplishment. Finally, it will help spur the creation of a recycling network for the listed materials.

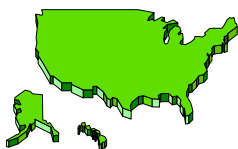
The intent of the recommendations is not to provide new enforcement options against operators of municipal solid waste combustors. Provided that operators are complying with existing requirements of law and permits, and do not intentionally and knowingly direct the listed materials into their combustors, they should not be covered by the new law. Enforcement against individuals of the new ban should take place only if it can be demonstrated that they intentionally and knowingly disposed of the listed materials in defiance of the ban.

The State of Minnesota has already banned the landfill and incinerator disposal of certain mercury-bearing materials, including thermometers, thermostats, fluorescent lamps, switches, appliances, batteries and medical or scientific instruments unless the mercury is first removed (MN Stat.115A.932, 115A.9561,116.92, 116.93, and 216B.241.) Michigan currently bans the incineration of used oil and yard clippings, but imposes responsibility for compliance on the incinerator operator.

The Healthcare Subgroup, not necessarily the entire M2P2 Task Force, also recognizes that if voluntary P2 efforts are not successful in reducing mercury in health care institutions, then legislation should be considered, including:

4. Legislation that requires health care facilities to demonstrate that they have instituted a process to reduce uses and separate wastes known to contain mercury from their waste stream before wastes are shipped for incineration or incinerated on site. This requirement would take effect by the Year 2002 for all health care facilities, allowing health care facilities time to make the transition to mercury-free products. Health care facilities can meet the demonstration requirements by certifying that they have eliminated their purchase of mercury-containing products. The administrative burden of the demonstration would be minimal. The demonstration would be a self-reporting process with hospitals completing their own reports.

Many hospitals have put in place outstanding programs to reduce mercury use, to clean up mercury spills, and to properly handle mercury contaminated waste products. Other sectors of the health care community including nursing homes and smaller doctors offices and clinics, have no yet instituted these practices. Educational efforts are planned to inform health care staff at facilities of all sizes about mercury pollution prevention options.



6.0 RECOMMENDATIONS FOR NATIONAL EFFORTS

6.1. Overview of Key Efforts

National Mercury Task Force

Following the suspension of the sale of mercury from the U.S. Department of Defense (DOD) stockpile in 1994 by the DOD, a National Mercury Task Force was established chaired by USEPA and U.S. Office of Pollution Prevention and Toxics. This Task Force is developing a national strategy to address the numerous environmental issues on a national basis including recommendations on waste disposal options, appropriate regulations for mercury reductions and a solution for the long-term disposal of the national mercury stockpile.

USEPA's Virtual Elimination Program

The USEPA Great Lakes National Program Office (GLNPO) launched the Virtual Elimination (VE) Project in response to the commitment by the Great Lakes Water Quality Agreement to "virtually eliminate" bioaccumulative substances from the Great Lakes ecosystem. USEPA-GLNPO is initially focusing on PCBs and mercury and has allocated significant resources to this project. USEPA-GLNPO hired a contractor to draft a detailed background document that describes the sources, uses and regulations for mercury.⁶⁰ USEPA sponsored a workshop in September 1994 that included stakeholders in the region to participate and draft recommendations on how to reduce the use and release of PCBs and mercury. USEPA-GLNPO released an options paper in June of 1995 that includes recommendations and a framework that USEPA feels are feasible and effective to implement. USEPA identified five elements needed for a comprehensive mercury reduction strategy including:

- 1) increase public awareness
- 2) influence the supply of mercury
- 3) minimize the use of mercury
- 4) reduce uncontrolled releases and
- 5) manage disposal.

This options paper also addressed the importance of addressing the "life-cycle" of substances, from their development to their ultimate disposal. If focus to reduce the toxic substance is placed early on in the creation of the product, the cost of reducing the use and release may be less than attempting to reduce releases after disposal of the product. This common-sense approach mirrors the pollution prevention principles that the M2P2 Task Force is following.

USEPA/Environment Canada Binational Virtual Elimination Strategy for Persistent Toxic Substances for the Great Lakes

This VE pilot project has provided the background information that USEPA-GLNPO will apply to its effort on working with Canada to develop a Binational Strategy to reduce bioaccumulative pollutants to the Great Lakes. USEPA and Canada held a workshop in Windsor, Ontario to discuss the approach and goals for this Binational strategy.

Other national efforts including a summary of select CAA provisions and the Lake Superior Binational Program efforts are included in Section 5.1.

6.2 Recommendations on a National Level

Current M2P2 Task Force Efforts

The following recommendations were the basis of a letter sent to the Chairpersons of the National Mercury Task Force from the Michigan M2P2 Task Force Chairman dated October 6, 1995.

While the M2P2 Task Force efforts should address Michigan's mercury contribution, Michigan alone can not address contributions from sources outside our state. Because mercury is an extremely mobile pollutant, mercury can be deposited in Michigan from sources miles away via atmospheric transport and subsequent deposition. Many of these mercury P2/reduction efforts need to be addressed on a national basis. Accordingly, the M2P2 Task Force made a number of suggested actions aimed at various target audiences on which they strongly encourage the National Mercury Task Force to act.

Recommendations Were Made to The National Mercury Task Force to further facilitate immediate and ongoing P2 efforts:



- 1) Establish a national public education/awareness and outreach program to educate consumers and end-users of mercury-containing products on pollution prevention opportunities and available alternatives to these products as well as energy conservation opportunities. The educational information should explain the link to fish consumption advisories with focus on subsistence fish eating populations. The information should raise the awareness of the public about mercury cycling in the environment, and its toxicity potential and persistence.

The Following Recommendations

- 2) Emphasize mercury P2 efforts through existing EPA initiatives such as Project XL, 33/50, the Common Sense Initiative or model an effort that follows the national lead education and abatement program.
- 3) Increase dialogue with industry and manufacturers on ways to decrease and/or eliminate mercury from products and processes. These discussions should also include consideration of the effects of imported mercury-containing products and mercury stock availability (domestic and imported) on emissions and P2 efforts. Organizations approached should include trade associations, broad based organizations and voluntary standards organizations such as the American National Standards Institute (ANSI) and the American Society of Testing and Materials (ASTM). For example, discussions should consider the use of environmental management systems and life cycle analysis in the development of product related standards to help raise the awareness of design engineers about toxic substances, including mercury, at the front end of product development.

- 4) Encourage voluntary phase out of nonessential uses of mercury and replacement with environmentally safe alternatives. Many states are reluctant to act in the absence of a consistent, national policy which levels the playing field. EPA could show leadership by creating a national forum with the states and other key stakeholders in regards to mercury emissions and reduction guidelines.
- 5) Expand the Universal Waste Rule for mercury-containing products, such as fluorescent lamps, switches, high-intensity discharge lamps, thermometers and mercury-containing medical equipment.
- 6) Foster national recycling and/or buy back programs for mercury-containing wastes including fluorescent lights. The recycling effort for fluorescent lights could possibly be in conjunction with the EPA Green Lights Program.
- 7) Continue EPA's effort to encourage national energy conservation, including communications on the benefits of reduced emissions of pollutants from fossil fuel burning. EPA should broaden its effort by working in cooperation with the Department of Energy.
- 8) Develop a national labeling requirement for products or components which contain a significant percentage of mercury for its function or as an added ingredient. This would allow consumers and businesses to make informed choices in efforts to support pollution prevention progress.
- 9) Continue EPA's effort to find an alternative to the incineration of organo-mercuric wastes. Pursuant to RCRA, an allowed treatment of organic wastes containing mercury is incineration. This practice has contributed to the anthropogenic mercury loadings into the environment in Michigan and may undermine many of the current P2 effort underway.

"While Michigan's P2 efforts on mercury are encouraging, the degree of support from consumers, community organizations, businesses and county/local governments will likely be limited until the science on several key factors is better known."

**Also included in this letter were recommendations on:
RESEARCH AND DATA NEEDS FOR MERCURY IN THE
UNITED STATES**

The M2P2 Task Force recognizes that the degree to which various target audiences will act on P2 efforts may well depend on the state of scientific knowledge about mercury and its use, potential adverse effects and trends regarding emission sources, transport and ultimate fate. While Michigan's P2 efforts on mercury are encouraging, the degree of support from consumers, community

organizations, businesses and county/local governments will likely be limited until the science on several key factors is better known. The following ten recommendations about research and data needs aim to improve our scientific understanding about mercury. The M2P2 strongly encouraged the National Mercury Task Force to act positively and quickly on implementing these recommendations.

(Recommendations number 1-6 were adopted from the Michigan Environmental Science Board's report, "Mercury in Michigan's Environment: Environmental and Human Health Concerns (A Science Report to Governor John Engler)" April 1993.

1) Pregnant women in the nation should be periodically monitored to determine the current level of exposure to mercury and whether the exposure is changing. Hair and/or blood should be sampled at intervals not exceeding 5 years.

2) Ambient air monitoring should be conducted in and around urban areas to determine the sources and the geographic extent of high mercury concentrations. Elevated levels of ambient mercury have been found in Detroit and Chicago.

3) Undertake a national-scale investigation to obtain speciated mercury measurements in the plumes of all major mercury emission source types. This information is needed to determine which sources should be controlled and the impact any control measure will have on observed mercury concentrations. Plume measurements are much more useful than stack measurements because some gaseous mercury-two in the stack is likely to condense out to particulate mercury-two after exiting the stack. Concurrent stack and plume measurements will help determine the rate of this transformation.

4) Conduct a national study on mercury mass balance in clouds to provide insight on the importance of nucleation scavenging versus in-cloud oxidation. Cloud chambers could be utilized to test the importance of in-cloud elemental mercury oxidation, gaseous mercury-two washout and particulate mercury-two nucleation scavenging. This needs to be done in order to determine which form of mercury should be controlled.

5) Make a determination as to whether or not soils are a net source or sink for mercury by applying state-of-the-art dry deposition measurement techniques. Vertical profiling as a function of time of day and season are needed to characterize this source/sink. This information is needed in order to quantify the impact of reducing anthropogenic mercury emission sources.

6) EPA should establish a central repository to collect and maintain information resulting from various states, federal, regional and international research investigations and information on various state, federal and international legislative initiatives. The collected information should be developed into a comprehensive and up-to-date database on mercury. Currently, there is no single agency that tracks all the various mercury research issues.

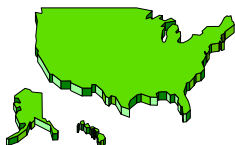
7). EPA should use multi-route exposure assessment modeling before establishing national emission limits for sources known to emit mercury. (Municipal waste incinerator standards and other incinerator standards must consider the bioaccumulative impacts of mercury in establishing adequate control levels. These standards should also include requirements for source reduction and pollution prevention of mercury-containing materials.)

8) Provide additional resources for the development of continuous emission monitoring (CEM) of mercury from such sources as incinerators and utilities.

9) In efforts to improve the scientific base of knowledge, the reporting thresholds for mercury emissions under the Toxic Chemical Release Inventory (TRI) may need to be evaluated. TRI reporting is required by Section 313 of Title III of the 1986 Superfund Amendments and Reauthorization Act (SARA 313).

10) EPA's Science Advisory Board, perhaps through the Clean Air Science Advisory Committee (CASAC), should review and scientifically evaluate the accumulated mercury information and provide recommendations to the Administrator based on new data and/or advancements in the understanding of mercury in the environment. As new research information becomes available, there will be a need for EPA to scientifically evaluate the material in terms of its impact on ongoing and/or proposed programs.

**approved analytical
methods and directions for laboratory use, handling and
recycling or proper disposal of mercury.**



**The M2P2
Task Force
Also
Recommends
the Following
Efforts be
Implemented
on a National
Scale:**

- **Michigan**
should
challenge
analytical
standards
setting
agencies
including
USEPA
and the
Standard
Methods
Joint
Editorial Board
to address
mercury
pollution
prevention
opportunities
through
revisions
to

The most recent manual (1995-19th Edition of Standard Methods for water and wastewater) does indicate that mercury use in the laboratory is a concern and some steps to reduce mercury have been taken. For instance, the new method for total kjedahl nitrogen does not use mercury as a catalyst and the nesslerization method, which used mercury, has been deleted. However, there still exists opportunities for further mercury pollution prevention efforts such as using alternative mercury-free test methods, where feasible. For example, mercuric sulfate is used in the COD (chemical oxygen demand) test. Alternate test procedures, such as TOC (total organic carbon) and BOD (biochemical oxygen demand), could possibly be used that satisfy the analytical need without the use of mercury. USEPA needs to evaluate whether the benefits of the COD test justify the use of mercury in the laboratory. The test could be eliminated or at least not required through the NPDES (National Pollutant Elimination System) permit program. Similarly, there are several different test methods for chloride, including the mercuric nitrate method, listed in Standard Methods For the Examination of Water and Wastewater. Mercury is also used for standard solutions (about 100 milligrams of mercury per standard solution set-up). The method calls for preparation of new standards daily. Efforts could include determining if less mercury could be used in the standard solution, reusing or recycling the solution could also be investigated and included in the test of the manual.

USEPA and/or the Joint Editorial Board for Standard Methods could be requested to review all methods utilizing mercury, to eliminate those for which there are acceptable alternative methods, and to otherwise reduce the use of mercury in the laboratory.

- **Michigan should pursue other sector standard setting organizations associated with the design phase of products which may have a significant impact on eliminating or lowering mercury use in future products. (Efforts similar to the SAE P2 white paper should be pursued by the State and other key stakeholders.)**
- **USEPA should pursue a voluntary P2 initiative for mercury with the chlor-alkali industry. Emphasis should be placed on conversion from the mercury cell process to either the membrane cell or diaphragm cell process. Although no facilities are located in Michigan, our state can be impacted by atmospheric transport and deposition from out-of-state facilities.**

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Tables 1.0-6.0

- 1.0 Consumer Products Known to Contain Mercury & Alternatives**
- 2.0 Health Care Products Known to Contain Mercury & Alternatives**
- 3.0 Mercury Pollution Prevention in Select Michigan Hospitals**
- 4.0 Dental Amalgam Use and Alternatives**
- 5.0 Mercury Uses in Electrical Applications and Alternatives**
- 6.0 Mercury Use and Alternatives in the Automobile Sector**

APPENDICES A-Q

- A. Mercury Use Trees**
- B. Sources of Mercury in Michigan**
- C. Speakers & Topics at Michigan Mercury Pollution Prevention Task Force Meetings**
- D. Education/Outreach Subgroup Members**
- E. Merc Concern Brochure**
- F. Merc Concern Brochure Distribution Channels**
- G. Expectant Mother's Guide to Eating Michigan Fish**
- H. Amalgam Waste Reduction & Recycling Brochure**
- I. Low Mercury Aqueous Cleaner Flyer**
- J. Auto Sector Subgroup Letter to Stakeholders**
- K. Ford, Chrysler and General Motors Letters to the M2P2 Task Force Chairman**
- L. AIAM Letter to the M2P2 Task Force Chairman**
- M. Letters associated with Society of Automotive Engineers Mercury Paper**
- N. Breakdown of Study Vehicles That Contain Mercury Switches**
- O. Michigan Generation Capacity Breakdown**
- P. Estimated Detroit Edison SO₂ Emission Rates Vs. Mercury in Coal Concentration**
- Q. The Lake Superior Pollution Prevention Strategy Implementation Plan: Recommendations for Achieving Zero Discharge - Recommendations for Mercury**

***NOTE**

Because the following Appendices were not available in an electronic format they are not available through Internet: Appendix A, E, G, H, I, J,K, L,M and N.

1.0 Consumer Products Known to Contain Mercury & Alternatives

| Discards Known to Contain Mercury | Pollution Prevention Alternatives |
|---|--|
| Thermometers | Red Bulb (Alcohol Thermometers Digital Thermometers) |
| Thermostats (Non-Electric Models) | Electronic Models and Snap Switches |
| Button Batteries | Mercury-Free Button Batteries (Zinc Air Type) |
| Silver Amalgam Waste* | Ask Your Dentist |
| Quicksilver Maze Toy | Mercury-Free Toys |
| Old Latex Paints (Since 1990, Hg has been banned from Interior Latex Paints & since 1991 for Exterior Latex Paints) | New Latex Paint |
| Some Shoes that Light Up* | Mercury-Free Shoes |
| Switches (Some Light and Appliance Switches) | Mechanical or Pressure Switches |
| Contact Lens Solution Containing Thimerosal* | Mercury-Free Solutions |
| Nasal Spray w/Thimerosal /phenylmercuric acetate * | Mercury-Free Spray |
| flame sensor (used in residential & commercial gas ranges, Hg is in capillary tube when heated Hg vaporizes and opens gas valve or operates switch. Used for both electrical or mechanical output.) | Hot surface ignition system for devices or products that have electrical connections. |
| Lights [Fluorescent & High Intensity Discharge (HID) Lamps] | (Fluorescent lights still contain mercury, however energy will be conserved thereby reducing mercury emissions from coal and oil combustion) |
| (*Note: The primary concern is the disposal and not the exposure to mercury. No studies have confirmed any health risk associated with the identified mercury applications.) | |

2.0 Health Care Products Known to Contain Mercury & Alternatives

| Alternatives for Mercury Uses in the Medical Facility | |
|--|---|
| PRODUCTS | ALTERNATIVES |
| Batteries Defibrillators Hearing aids Pacemakers | lithium, zinc air, alkaline |
| Electrical equipment | fiber optics, solid state devices, mechanical switches |
| Esophageal devices Cantor tubes Miller Abbot tubes | tungsten tubing (tungsten for weight) |
| Lamps fluorescent, high intensity, and ultraviolet | ordinary glow lights; low sodium vapor tubes (yellow); optical, high-energy, long-lasting lights ¹ |
| Sphygmomanometers | electronic vacuum gage, expansion, aneroid ² |
| Thermometers | electronic (digital), expansion, aneroid |
| CHEMICALS | ALTERNATIVES |
| Mercury (II) chloride Zenker's solution Histological fixatives | zinc Formalin freeze drying |
| Staining solutions and preservatives for such products as buffers and vaccines: Thimerosal, Immu-sal, Carbol-fuchin stain, Gram iodine stain, phenolic mercuric, acetate, alum, Hematoxylin "Solution A" | replace with variety of chemical compounds ³ |
| Mercury (II) oxide | copper catalyst |
| Mercury chloride | none identified |
| Mercury (II) chloride | magnesium chloride/sulfuric acid or zinc formalin, freeze drying |
| Mercury (II) sulfate | silver nitrate/potassium/chromium-(III) sulfate |
| Mercury iodide | phenate method |
| Mercury nitrate (for corrosion of copper alloys) for antifungal use (mercurochrome) | ammonia/copper sulfate neosporin, mycin |

1 No effective substitute exists for high energy fluorescent lights, but technology is reducing the volume of mercury required in such lights.

2 Mercury thermometers and manometers should be phased out because good substitutes exist. Mercury recycling should be practiced from old medical instruments (see section 3.2.4).

3. Mercury's use in chemical analysis can be phased out in many cases, especially in Zenker's solution and histological fixatives. Some substitutes, such as copper, tin and chromium compounds also have some risk, but less than the risk associated with mercury. The total use of mercury remaining in such products as antiseptics, diuretics and skin preparations is minimal; mercury should not be used in skin lightening soaps and creams.

3.0 MERCURY POLLUTION PREVENTION IN SELECT MICHIGAN HOSPITALS

| | Alpena | Bronson, Kalamazoo | Butterworth , Grand Rapids | Henry Ford, Detroit | Genesys, Flint | Riverside, Trenton | U of M, Ann Arbor | Corning Clinical, Wyoming |
|--|--------|-----------------------|----------------------------------|---------------------------|-------------------|-----------------------|-------------------------|---------------------------------|
| Administrative Directives - Purchasing, etc. (Formal vs. Informal) | ✓F | ✓F | ✓F | ✓F | ✓I | ✓I | ✓I | ✓F |
| Clean Drain Traps/Catch Basins | ✓ | | | ✓ | | ✓ | | ✓ |
| Educate Staff | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ |
| Install Energy Efficient Lighting | | | | ✓ | | ✓ | ✓ | |
| Inventory Mercury Uses | ✓ | | ✓ | ✓ | | ✓ | ✓ | ✓ |
| Mercury Free Batteries | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ |
| Purchase New Mercury - free Sphygmomanometers | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | NA |
| Replace Broken Sphygmomanometers w/mercury free units | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | NA |
| Replace Thermometers | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | |
| Separate Wastes | ✓ | | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ |
| Substitute Pathology Lab Reagents | ✓ | | | | | ✓ | | ✓ |
| Training on Spill Prevention/ Management | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ |

Compiled by National Wildlife Federation, August, 1995

4.0 DENTAL AMALGAM USE AND ALTERNATIVES

| Critical Parameters in Evaluating Posterior Restorative Materials | AMALGAM | COMPOSITE | GLASS IONOMER | GOLD FOIL | GOLD ALLOY (CAST) | METAL-CERAMIC CROWNS |
|---|--|--|--|--|--|---|
| Median Longevity Estimate | 8 to 12 years | 6 to 8 years | No data: ¹ 5 years predicted | No data: 10 to 15 years estimated | 12 to 18 years | 12 to 18 years |
| Relative Surface Wear | Wears slightly faster than enamel | Excessive wear in stress-bearing situations | Excessive wear in stress-bearing situations | excessive wear in stress-bearing situation | Wears similar to enamel | Porcelain surface may wear opposing tooth |
| Resistance to Fracture | Fair to excellent | Poor to excellent | Poor | Fair to good | Excellent | Excellent |
| Marginal Integrity (leakage) | Fair to excellent Self-sealing through corrosion products | Poor to excellent Polymerization shrinkage can cause poor margins | Poor to excellent | Poor to excellent | Fair to good Depends upon fit and type of buting agent used | Poor to excellent Depends on fit and type of buting agent used |
| Conservation of Tooth Structure | Good | Excellent | Excellent - if initial restoration, not if replacement | Good | Poor | Poor |
| Esthetics | Poor | Excellent | Good | Poor | Poor | Excellent |
| Indications: | | | | | | |
| Age range | All ages | All ages | All ages | Adult | Adult | Adult |
| Occlusal stress | Moderate stress | Low-stress bearing | Adult - Class V and low-stress primary teeth | Class III and V and crown repair | High-stress areas | High-stress areas |
| Extent of caries | Incipient to moderate size cavity | Incipient to moderate size cavity | Class I and II child incipient to moderate size cavity | Incipient to moderate size cavity | Severe tooth destruction | Severe tooth destruction or esthetic considerations |
| Cost to Patient ² | IX | 1.5X | 1.4X | 4X | 3X + gold | 8X |

Longevity estimates reflect from published studies, however, under different clinical situations many restorations will last longer. For materials which have emerged in the last decade and gold foil, estimates are speculative.

² Relative cost to patient, in relation to amalgam (1X). There may also be considerable geographic variation.

April 1996
Final Report

Adopted from: Dental Amalgam: A Scientific Review & Recommended Public Health Service Strategy for Research, Education & Regulation, Dept. HHS, January, 1993.

5.0 Mercury Uses in Electrical Applications and Alternatives

| PRODUCTS KNOWN TO CONTAIN MERCURY & APPLICATION (if known) | QUANTITY OF MERCURY (if known) | AVAILABLE ALTERNATIVES |
|---|--|---|
| <u>Batteries *</u> (dry cell) | | |
| mercuric oxide (button cells, for use in hearing aids, pagers, watches, medical uses, old smoke detectors...) | 40% by weight (up to 1,200 mg) ? | zinc-air (some 9V still contain Hg) (2% Hg, prior to '85) silver-oxide (1% Hg, prior to '85 now may have ≤ 25 mg) |
| alkaline-manganese (AAA, AA, C, D, 9V) | 1% by weight (up to 60 mg) (prior to 1992) | mercury free versions that use indium, gallium & magnesium. Only 1-3 ppm residual Hg present. |
| zinc carbon (AAA, AA, C, D, 9V) | Up to 1% by weight (prior to 1992) | mercury free versions |
| <u>Lights</u> | | |
| • fluorescent lights | 8-90 mg (average 4' lamp: 20-50 mg) | none (fluorescent lights still contain mercury, but are much more energy efficient & will conserve energy thereby reducing mercury emissions from coal and oil combustion) |
| • high intensity discharge (HID) lights (3 types) | | (HID lights are also more energy efficient thereby reducing mercury emissions from coal and oil combustion) |
| 1. mercury vapor (some street lights and car headlights) | 26-250 mg (car headlights contain 0.5 - 1 mg) | (standard halogen or tungsten filament for car headlights) |
| 2. metal halide | 30-250 mg | ? |
| 3. High Pressure Sodium (HPS) (street & parking lights) | 8-25 mg | Low Pressure Sodium |

| ...PRODUCTS KNOWN TO CONTAIN MERCURY & APPLICATION (if known) | QUANTITY OF MERCURY (if known) | AVAILABLE ALTERNATIVES |
|---|--------------------------------------|---|
| Switches (4 types) | | |
| 1. Mercury Switch (tilt switch) | | |
| • thermostats | 3,000 - 6,000 mg | electronic type and snap switches |
| • float control (septic tank & sump pumps) | ? | magnetic dry reed switch, optic sensor or mechanical switch |
| • some automobile trunk & hood lights | 500 - 1,000 mg | mechanical switch |
| • freezer light | 2,000 mg | mechanical switch |
| • washing machine (power shut off) | 2,000 mg | mechanical switch |
| • Silent Switches (light switches prior to 1991) | 2,600 mg | mechanical switch |
| 2. Mercury wetted reed switch (magnetically activated) | 140 - 3,000 mg | magnetic dry reed switch |
| 3. Reed Relays (contains the reed switch) (low voltage, high precision analytical equipment i.e. electron microscope) | 140 -3,000 mg | solid state, electro- optical or dry reed relay |
| 4. Plunger or Displacement Relay (high current/high voltage applications including lighting, resistance heating, power supply switching. Examples include large commercial equipment such as welders, PVC pipe manufacturing, pizza ovens and french fry machines) | Up to 160,000 mg | mechanical switch |

| ...PRODUCTS KNOWN TO CONTAIN MERCURY & APPLICATION (if known) | QUANTITY OF MERCURY (if known) | AVAILABLE ALTERNATIVES |
|--|--------------------------------------|--|
| Thermo-electrical Applications | | |
| accustat ("mercury in glass thermostat," a calibrated device resembling a thermometer is used to provide precise temperature control for specialized applications) | ~ 1,000 mg | ? |
| flame sensor (used in residential & commercial gas ranges, Hg is in capillary tube when heated Hg vaporizes and opens gas valve or operates switch. Used for both electrical or mechanical output.) | 2,500 mg | Hot surface ignition system for devices or products that have electrical connections. |

Information in table adapted from:

- EPA Report 600/R-94/047 "Mercury usage and alternatives in the electrical and electronics industries." Final Report. January 1994.
- Clear, R. and Berman, S. 1994. Environmental and health aspects of lighting: mercury. Journal of the Illuminating Engineering Society. p. 147.
- Gilkeson, J. 1995. Personal communication from John Gilkeson, Minnesota Pollution Control Agency, Hazardous Waste Division to Joy K. Taylor, Michigan Department of Environmental Quality, Air Quality Division.

*See Section 5.1 for a description of the Michigan Battery Act.

6.0 Mercury Uses in Automobiles and Alternatives

| PRODUCTS KNOWN TO CONTAIN MERCURY | QUANTITY OF MERCURY (if known) | KNOWN/ POSSIBLE USE | AVAILABLE ALTERNATIVE |
|--|---------------------------------------|---|---|
| airbag sensors | not confirmed | confirmed on several models per Appendix L¹ | mercury-free versions |
| antilock braking systems (ABS) | ~ 3,000 mg | apparently have been used on some four wheeled drive vehicles; use on other ABS vehicles unknown² | |
| headlamps | 0.5 - 1 mg | used in high intensity discharge (HID) lamps by one importing manufacturer in the 90's & by one domestic manufacturer as an option in one 1995 model³ | standard halogen or tungsten filament for car headlights |
| radios | ? | rechargeable batteries for radios; in use by one or more importing manufacturer | mercury free versions |
| ride control | ~1,000 mg | in use by one or more manufacturer | |
| remote transmitters | ? | mercury oxide batteries | mercury free versions (zinc air) |
| light switches | 1,000 mg | known: used to activate convenience lighting in trunk, underhood (See <u>Appendix M</u> for sample of company lines based on MN study.) | various electro-mechanical switches being explored |
| speedometer systems | < 40 mg | In use by one or more importing manufacturers | |

1 air bags are used to meet a required safety requirement

2 anti-lock braking systems (ABS) - some reportedly use one or more mercury switch, but ABS function is to improve vehicle safety

3 high intensity discharge (HID) headlamps - one manufacturer reported this will allow for improved visibility, better aerodynamic shaping of vehicle, resulting in better fuel economy; uses less energy than current headlamps; daytime running lights are NOT the same as HID headlamps

Appendix B.1

1994 ESTIMATE OF ANTHROPOGENIC MERCURY AIR EMISSIONS IN MICHIGAN

| Emission Source (Number of sources within Michigan) | Mercury Emissions (lbs/year) | % of State Total |
|--|------------------------------|------------------|
| FUEL COMBUSTION | | |
| Coal combustion | | |
| Electric Utilities | 2,210 ¹ -4,240 | 41% |
| Residential | NA | NA |
| Industrial/Commercial | 680 | 6.5% |
| Oil Combustion | | |
| Electric Utilities | 10 | <1% |
| Residential | 175 | 1.7% |
| Industrial/Commercial | 20 | <1% |
| Wood Combustion | | |
| Electric Utilities | 10 | <1% |
| Residential | 10 ² | <1% |
| Industrial/Commercial | 10 | <1% |
| Natural Gas Combustion ³ | NA | NA |
| Petroleum Refining ⁴ | NA | NA |
| TOTAL FOR FUEL COMBUSTION | 3,125-5,155 | |
| | | |
| INCINERATION | | |
| Sewage (18) | 65 | <1% |
| Hospital Waste (148) | 980 | 9.4% |
| Municipal Waste (5) | 2,915 | 28% |
| Hazardous Waste Incineration (3) | 280 | 2.7% |
| TOTAL FOR INCINERATION | 4,240 | |
| | | |
| INDUSTRIAL SOURCES | | |
| Lime Manufacturing (6) | 170 | 1.6% |
| Cement Manufacturing (4) | 465 | 4.5% |
| Light bulb Recyclers ⁵ (1) | 0-15 | <1% |
| Coke Producers (1) | NA | NA |
| Copper Smelting ⁶ (1) | 0 | 0% |
| TOTAL FOR INDUSTRIAL SOURCES | 650 | |
| | | |
| AREA SOURCES | | |
| Cremation ⁷ (41) | 40 | <1% |
| Lamp Manufacturing/Breakage ⁸ | 330 | 3.2% |
| TOTAL FOR AREA SOURCES | 370 | |
| | | |
| TOTAL MERCURY AIR EMISSIONS | 8,385-10,415 | 100% |

...Appendix B.1

- 1) Mercury emissions reported by Detroit Edison (1,468 lbs) and Consumers Powers (739 lbs) in letters to the Michigan Public Service Commission, dated January 5, 1996 and March 7, 1995, respectively. DEQ-AQD estimates total mercury emission rate for all Michigan electric utility-coal combustion sources to be 4,241 pounds (calculated based on Detroit Edison and Consumers Power Company emission factors and throughput data from Michigan's Emission Inventory database).
- 2) Value was calculated using tons of wood consumed in 1992 (869,803) ("Residential Fuelwood Consumption and Production in Michigan, 1992" by Dennis M. May, Anthony K. Weatherspoon, and Ronald L. Hackett) and the emission factor from FIRE SCC code 10100903* (wood fired boiler): 6.5E-6 lbs/ton.
- 3) Maxwell, W. 1996. Personal communication with Bill Maxwell, USEPA, OAQPS to Ed Lancaster, Michigan Department of Environmental Quality, Air Quality Division. An estimate was not calculated due to the wide range of emission factors reported (<.38 pounds per trillion BTU-11.363 pounds per trillion BTU), and the low factor quality rating assigned to these emission factors.
- 4) Insufficient data to calculate an annual emission at the time of printing.
- 5) Holladay, J. 1996. Personal communication from Joe Holladay, GREENLITES Lamp Recycling, Inc. to Ed Lancaster, Michigan Department of Environmental Quality, Air Quality Division. The value of 13 pounds per year is based on the company running 24 hours/day 365 days/year.
- 6) Source currently not operating. This facility ceased operations of its smelter indefinitely, in February 1995.
- 7) Number of cremations in Michigan reported by the Cremationist Association of North America.
- 8) Letters to MDEQ-AQD, from Greenlites Lamp Recycling, Inc., dated November 14, 1995, and the National Electrical Manufacturers Association, December 1, 1995.

Appendix B.2

| 1995 ESTIMATE of MERCURY in the MUNICIPAL\COMMERCIAL SOLID WASTE STREAM¹ | |
|--|--------------------|
| Batteries ² | 495 |
| Lamp Manufacturing/Breakage | 2,200 |
| Paint Residues/Pigments | 0 |
| Dental Amalgam Preparation | 60 |
| Laboratory Use | 60 |
| Thermostats | 605 |
| Light Switches | 140 |
| Electrical Switches (Automotive) ³ | 190-240 |
| | |
| Total for Municipal Solid Waste Stream | 3,750-3,800 |

- 1) U.S. EPA. "Mercury Study Report to Congress-Draft", December 1994. Emission Rates were calculated by multiplying the percentage of Michigan's population (3.74%) by the 1990 U. S. population. Except where otherwise noted.
- 2) U.S. Bureau of Mines (1994)
- 3) Utter, K. 1995. Personal communication from Kent Utter, Automotive Recyclers of Michigan, to Ed Lancaster, Michigan Department of Environmental Quality, Air Quality Division. Mr. Utter estimated approximately 250,000 vehicles are disposed of each year in Michigan. Based on this estimate and the study conducted by the Minnesota Pollution Control Agency, this would result in the disposal of 190-240 pounds of mercury per year in Michigan.

Appendix B.3

WATER DISCHARGE OF MERCURY

Industrial use and discharge of mercury-containing materials is tracked by the Critical Materials Register (CMR) and the Annual Wastewater Report (AWR), administered by the Surface Water Quality Division, MDEQ. One hundred and sixty of the facilities required to report, reported that between 2,720 and 10,420 pounds of mercury waste were disposed of by means other than wastewater discharge or air emissions (Hull, 1995, personal communication.)

Michigan Facilities Reporting under the CMR and AWR Requirements

| Year | Number of Facilities | MI Facilities Reporting Mercury Use (pounds) |
|------|----------------------|--|
| 1990 | 203 | 260,000-272,000 |
| 1991 | 270 | 288,000-308,000 |

(1993 data is expected to increase due to improved data quality)

Discharges to Municipal Wastewater Treatment Plants (WWTP) or the Waters (surface water or groundwater) of the State under CMR/AWR Requirements

| Year | Number of Facilities | Mercury Discharges (pounds) |
|------|----------------------|-----------------------------|
| 1990 | 89 | 160-1,200 |
| 1991 | 121 | 200-1,800 |

Hull, C. 1995. Personal communication with Christopher Hull, Surface Water Quality Division, Michigan Department of Environmental Quality, with Ed Lancaster, Air Quality Division, Michigan Department of Environmental Quality.

...Appendix B.3

Waste Transportation

The Hazardous Waste Manifest Tracking System, required under Act 451 of 1994 of the Michigan Hazardous Waste Code Part 111, administered by the Waste Management Division, MDEQ reported the following information for Michigan facilities that generate and receive mercury-containing hazardous wastes for treatment, storage or disposal (Petrovich, 1995, personal communication.)

Facilities in Michigan that Generate Mercury-Containing Wastes

| Year | Number of Facilities | Volume (pounds) |
|------|----------------------|-----------------|
| 1990 | 124 | 2,130,000 |
| 1991 | 157 | 1,944,000 |
| 1992 | 182 | 6,700,000 |
| 1993 | 202 | 926,000 |
| 1994 | 251 | 888,000 |

Facilities in Michigan that Receive Mercury- Containing Wastes for Treatment, Storage or Disposal

| Year | Number of Facilities | Volume (pounds) |
|------|----------------------|-----------------|
| 1990 | 12 | 2,854,000 |
| 1991 | 11 | 2,402,000 |
| 1992 | 11 | 7,958,000 |
| 1993 | 14 | 3,606,000 |
| 1994 | 10 | 7,566,000 |

Note: The percent of mercury in this waste is not known, however, in order to be classified as a D009 listed waste, the waste must have a minimum mercury concentration of 0.2 ppm.

Petrovich, L. 1995. Personal communication with Lee Petrovich, Waste Management Division, Michigan Department of Environmental Quality, with Ed Lancaster, Air Quality Division, Michigan Department of Environmental Quality.

Appendix C

Speakers & Topics at M2P2 Task Force Meetings

August 17, 1994 M2P2 Task Force Meeting

- Kim Paksi, MDEQ-Environmental Assistance Division (EAD), "What is P2?"
- Joy K. Taylor, MDEQ-AQD, "Known Anthropogenic Air Sources of Mercury in Michigan"
- Bob Babcock, MDEQ-SWQD, "Known Anthropogenic Water Sources of Mercury in Michigan"

October 11, 1994 M2P2 Task Force Meeting

- Jim Giattina, Deputy Director, Great Lakes National Program, USEPA, "Overview of EPA's Virtual Elimination Project on Mercury"
- Kim Paksi, MDEQ-EAD, "Overview of Lake Superior Pollution Prevention Efforts"
- Pat Carey, Minnesota Pollution Control Agency, "Overview of Minnesota's Mercury Reduction Efforts"

November 22, 1994 M2P2 Task Force Meeting

- Chris Hull, MDEQ-SWQD, "Act 293: Critical Materials & Wastewater Reporting - An Overview of Two Programs"
- Bob Babcock, Jill Revard & J.J. Jones, MDEQ-SWQD, "Overview of Mercury Reduction Plans - An Alternate for Indirect Dischargers"
- Tim Eder, National Wildlife Federation, "Overview of Mercury Reduction Prospectus for the City of Detroit"

December 19, 1994 M2P2 Task Force Meeting

- Paul Proudfoot, PSC, "Overview of Integrated Resource Plans (IRPs) & the PSC Involvement with the Electric Utility Industry"
- Tom Wrenbeck, DSM Unit, Detroit Edison, "Electric Utilities & P2"
- Blair Orr, Professor - School of Forestry, Michigan Technological University, "Overview of the Symposium on Economic Incentives to Implement Zero Discharge."
- Jan Patrick, Department of Commerce, PSC - Conservation Programs, Competitive Utility & Energy Resources Division, "Energy Efficiency Opportunities in State Facilities as a P2 Strategy."

March 28, 1995 M2P2 Task Force Meeting

- Dr. Larry Fischer, Institute for Environmental Toxicology, Michigan State University, "Update on Mercury and Human Health Risks."

May 31, 1995 M2P2 Task Force Meeting

- George Boersma, Director, Office of Purchasing, Department of Management and Budget, "Overview of State Procurement Policies."
- Kathe Rushford Carter, Director, Office of Support Services, Department of Management and Budget, "State Energy Audits & Current Efforts."
- Angela Bandemehr, Regional Mercury Air Coordinator, EPA-Region 5, "Overview of EPA's Green Lights Program."

October 3, 1995 M2P2 Task Force Meeting

- Terry Guerin, President, Terra Environmental Technologies, Inc., "Mercury Emissions from Landfills."

Appendix D

List of Education/Outreach Subgroup Members

* denotes subgroup lead

• GENERAL PUBLIC

Joan Hughes *
Dave Dempsey
Peg Hall
Dennis Leonard
Joy Taylor
Jim Hallan



• HEALTH CARE SECTOR

Pier-George Zaroni *
Joan Hughes
Tim Eder
Joy Taylor
Steve Kratzer



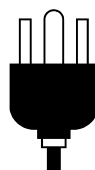
• DENTAL SECTOR

Nathaniel Rowe *
Connie Verhagen
Joan Hughes
Steve Kratzer



• ELECTRICAL USERS/ MANUFACTURES

Dennis Leonard *
Larry Slimak



• CHEMICAL SECTOR

Gary Burke *
Andy Such



• AUTOMOBILE SECTOR

Larry Slimak *
Jonathan Bulkley
Tim Eder



Appendix F

Merc Concern Distribution Channels

- Adcraft Club of Detroit
- Air & Waste Management Association
- American Board of Emergency Medicine
(Also include Terrene Brochure)
- American Lung Association of Michigan
- American Society of Safety Engineers
- Associated Builders & Contractors -
Central and Western Michigan Chapters
- Association for Child Development
- Association for Retarded Citizens/
Oakland County and Greater Lansing
- Association for Shared Childbirth
- Association of HMOs in Michigan
(Also include Terrene Brochure)
- Council of Michigan Foundations
- Consumers through Retail Outlets
- Cranbrook Institute of Science
- Cultural Groups (Hispanic and
Caribbean groups that use mercury
for religious practices)
- Ecology Center of Ann Arbor
- Energy Michigan, Inc.
- Federated Garden Clubs of Michigan, Inc.

- Fishing License Applicants (Need to check with Fisheries Division)
- Grand Valley State University Water Resources Institute
- Health Care Association of Michigan (Also include Terrene Brochure)
- Hospital Council of Western Michigan (Also include Terrene Brochure)
- Keep Michigan Beautiful, Inc.
- Lake Michigan Federation
- Lake Michigan Forum
- League of Women Voters of Michigan
- Learning Disabilities Association of Michigan
- Libraries
- Mechanical Contractors Associations
- MERRA Research, Development & Communication Center
- Michigan Academy of Physician Assistants (Also include Terrene Brochure)

...Appendix F

- Michigan Advertising Industry Alliance
- Michigan Alliance for Environmental & Outdoor Education
- Michigan Association for Local Public Health (Also include Terrene Brochure)
- Michigan Association of Dental Labs (Include Dental Brochure)
- Michigan Associations of Osteopathic Physicians & Surgeons (Also include Terrene Brochure)
- Michigan Associations of Pediatricians (Also include Terrene Brochure)
- Michigan College of Emergency Physicians/Michigan Chapter (Also include Terrene Brochure)
- Michigan Council for Geographic Education
- Michigan Council of Trout Unlimited
- Michigan Education Association
- Michigan Environmental Health Association
- Michigan Health Council
- Michigan Health and Hospital Association

Michigan

- Michigan Hospitals
Lake & Stream Association, Inc.
- Michigan Licensed Practical Nurses Association (Also include Terrene Brochure)
- Michigan Natural Areas Council
- Michigan Pharmacists Association (Also include Terrene Brochure)
- Michigan Restaurant Association
- Michigan State Chiropractic Association (Also include Terrene Brochure)
- Michigan State Medical Society (Also include Terrene Brochure)
- Muskegon Ottawa Pollution Prevention Alliance
- National Organization for Women
- Natural Areas Association
- Public Interest Research Group in Michigan (PIRGIM)
- Safety Council for Southeast Michigan
- Specialty Shop Owners (Those that sell mercury maze toy)
- Science Teachers
- State, County, and Local Public Health Departments
- Theater Owners (with old popcorn machines) - yet to be determined
- Woman-Infant and Children (WIC) Offices

APPENDIX O

MICHIGAN GENERATION CAPACITY BREAKDOWN

(in Megawatts)

| | Coal | Oil | Gas | Nuclear | Hydro | Other ¹ | Total |
|----------------------------|--------|--------------------|------------------|---------|-------|--------------------|--------|
| Consumers Power Co. | 2,832 | 678 | 2,341 | 847 | 1,107 | 151 | 7,956 |
| Detroit Edison Co. | 6,917 | 1,176 ² | 281 ² | 1,100 | 917 | 48 | 10,439 |
| Municipal Utilities | 1,130 | 246 | 154 | 0 | 47 | 3 | 1,579 |
| Other Utilities | 639 | 63 | 0 | 2,110 | 146 | 0 | 2,958 |
| TOTALS | 11,518 | 986 | 2,495 | 4,057 | 2,218 | 202 | 21,475 |
| Percent of TOTAL | 54% | 5% | 12% | 19% | 10% | 1% | |

¹Other includes, but not limited to, biomass, landfill gas, solar, wind and refuse

²United are capable of burning either gas or oil

Developed by Consumers Power and Detroit Edison

APPENDIX Q

THE LAKE SUPERIOR POLLUTION PREVENTION STRATEGY IMPLEMENTATION PLAN:

Recommendations for Achieving Zero Discharge Concerns & Recommendations for MERCURY (p. 21-22)

Mercury

Inventory

- Complete source identification in the areas of household hazardous waste, mine dewatering, atmospheric deposition, and nonpoint source runoff.

Targeted Elimination

- Eliminate nonessential uses of mercury (e.g., toys, shoes, batteries). The states bordering Lake Superior have or are in the process of passing legislation toward this goal. National legislation is needed.
- Phase out use of mercury currently in the consumer loop by first reducing, then recycling, and ultimately eliminating uses. The first goal is to prevent new additions of mercury to consumer products and industrial processes.
- Provide stepped incentives that would eliminate the use of existing stocks of banned mercury-containing pesticides.
- Pursue conversion of chlor-alkali plants to non mercury manufacturing processes.

Information and Technical Assistance

- Create informational and educational programs promoting pollution prevention for basin wide and nationwide use in reaching Publicly Owned Treatment Works (POTWs), consumers, targeted industries, and professional audiences.
- Promote reduction of mercury emission through energy conservation: establish a buy-back program for fluorescent lights and switches, reclassify used fluorescent lights as special wastes to be recovered, convene a work group of utilities in the basin to evaluate demand-side management strategies for reducing emissions.
- Promote EPA Energy Star programs like Green Lights and Energy Star Buildings.
- Coordinate dissemination of pollution prevention information through mentoring, technical assistance, and planning reductions of toxic substances (e.g., multimedia audits of small and medium-size businesses, pilot projects for zero discharge and emission, outreach information for the consumer public, continued pollutant recovery and collection programs).

Modification of Regulations

- Accelerate mandatory controls on existing, new, or modified sources of mercury. Bioaccumulative effects must be considered when developing emission standards for sources.
- Develop and implement improved EPA-approved test methods for air and water, specifically a stack test protocol including mercury speciation, and lower levels of detection for water analysis.
- Promote the use of nonmercury containing equipment for analytical testing in the environmental protection field and the medical industry.
- Discourage incineration as the legal disposal alternative for regulated wastes containing mercury. Provide incentives for screening municipal waste so that mercury-containing consumer products are not incinerated.

- **Implement the action items identified by the Great Waters Report for the Clean Air Act:**
 - **Lower emission rates for hazardous pollutants including mercury.**
 - **Establish the minimum level of mercury based on its bioaccumulative potential.**
 - **Emphasize pollution prevention as the goal in development of mercury control measures.**